VOL. V. NO. 2 SEPTEMBER, 1923

PROCEEDINGS

OF THE

HAWAIIAN ENTOMOLOGICAL SOCIETY

FOR THE YEAR 1922

HONOLULU, HAWAII

PRICE 75 CENTS

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All correspondence should be addressed to the Secretary, Hawaiian Entomological Society, Honolulu, Hawaii, from whom copies of the Proceedings may be purchased.

Volume I of the Proceedings, for 1905-07 (in five numbers), contains 210 pages, 4 plates, and 5 text figures.

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PROCEEDINGS

OF THE

Hawaiian Entomological Society

VOL. V, NO. 2. FOR THE YEAR 1922. SEPTEMBER, 1923

JANUARY 5, 1922.

The 195th meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association. Members present, besides Vice-President Fullaway, who presided, were Messrs. Bissell, Bryan, Ehrhorn, Giffard, Illingworth, Muir, Rosa, Swezey, Soon, Timberlake, Wilder, and Willard.

Minutes of the previous meeting were read and approved.

The Secretary reported that the Executive Committee had made the following appointments: Curator of Insects and Librarian, Mr. P. H. Timberlake; Editor of the Proceedings, Mr. O. H. Swezey.

PAPER READ.

"The Leaf-Miners of Pipturus (Lepidoptera)."

BY O. H. SWEZEY.

NOTES AND EXHIBITIONS.

Exhibition of a large collection of insects from Kokee, Kauai, August, 1921, by O. H. Swezey.

Fossil Insects.—Mr. Muir exhibited a pamphlet, entitled "Mesozoic Insects of Queensland," by Dr. R. J. Tillyard. He called attention particularly to the excellence of the photographs, in which the veins and even the hairs on the insect wings were easily discernible.

Supella supellectilium (Serv.).—Mr. Bryan exhibited a specimen of this recently introduced Australian roach, which was

captured January 3, 1922, in the cottage of Colonel Clark at the Kamehameha Boys' School, Honolulu, by Miss Clark.

Plagithmysus munroi (a correction). — Mr. Swezey called attention to Nos. 5 and 6 in Dr. Perkins' paper on Plagithmysides (Proc. Haw. Ent. Soc., IV, 996, 1921), and to the fact that the name of the species had been omitted in the manuscript. A surmised determination as *P. munroi* was supplied in a footnote. Recently the specimens were returned by Dr. Perkins, and these, Nos. 5 and 6, were found to be labeled *P. concolor*, hence, this is the name to be supplied for notes 5 and 6 in the paper.

FEBRUARY 2, 1922.

The 196th meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association, and was presided over by Vice-President D. T. Fullaway. Other members present were Messrs. Bissell, Bryan, Ehrhorn, Giffard, Illingworth, Muir, Rosa, Soon, Swezey, Timberlake, and Willard. Mr. W. H. Cowdry was a visitor.

The minutes of the previous meeting were read and approved.

PAPERS.

"The Erythrina Twig-Borer (Terastia meticulosalis) in Hawaii (Pyralidae, Lepidoptera)."

BY O. H. SWEZEY.

"Notes on Diptera Occurring in Hawaii."

BY J. F. ILLINGWORTH.

"Description of Two Flies Attacking Lantana (Diptera)."

BY DR. J. M. ALDRICH.

(Presented by Mr. Swezey.)

*** "Preliminary Notes on Pseudoscorpions."**

BY E. H. BRYAN, JR.

ENTOMOLOGICAL NOTES.

Synthesiomyia brasiliana.—Mr. Illingworth exhibited speci-

* Withdrawn from publication. [Ed.]

mens of this fly, and masses of its pupa cases. He called attention to its peculiar habit of pupation, consisting of forming its puparia among the hair on the carcass of its host, so near together that, after their emergence, the holes resemble honeycomb.

Scymnus sp.—Mr. Timberlake reported the discovery of a new Coccinellid, which has been confused in collections with the so-called *Rhyzobius ventralis,* which it resembles in size and coloration. This species agrees in many respects with the Australian species *Scymnus varipes* (Blackburn), but is apparently distinct. It is almost unquestionably one of the species introduced by Koebele years ago from Australia, and may have been confused at the time of introduction with the so-called *ventralis.* The specimens exhibited were all taken in the mountains back of Honolulu from Pacific Heights and Konahuanui to Kuliouou. The earliest collected specimen seen was taken January 1, 1905, on Tantalus, by Mr. Giffard.

Lindorus sp.—Mr. Timberlake called attention to the fact that the Coccinellid, passing under the name of *Rhyzobius ventralis* in both California and the Hawaiian Islands, is evidently not the species described by Erichson. Both it and the true *ventralis* belong to the genus *Lindorus.*

Sinoxylon conigerum.—Mr. Fullaway exhibited specimens of this beetle, which is doing damage to lead cables on the islands of Maui and Hawaii.

Epagoge infaustana.—Mr. Swezey exhibited a series of this Tortricid moth, reared from larvae on *Pipturus,* collected in Makaleha Valley, January 8, 1922. Dr. Perkins collected this moth abundantly on Kauai, Maui, Molokai, and Hawaii, but not on Oahu. Mr. Swezey had previously reared a few specimens from larvae boring in the tips of twigs of *Pipturus* on Tantalus. One tree was found in Makaleha Valley on which were hundreds of the larvae. They were feeding on the leaves, skeletonizing them, and hiding in webbed-together leaves at the tip, or a bit of the turned-over edge. They pupated in similar places. A score or so of leaves with larvae were collected, and from these twenty-two moths issued January 19 to 28, and two of the para-

site, *Cremastus hymeniae*. This adds another to the large number of hosts of this parasite.

Lantana Flies.—Mr. Swezey exhibited paratypes of two flies as recently returned to him by Dr. Aldrich. One of the flies is the lantana stem gall-fly, *Eutreta xanthochaeta* n. sp., the other the lantana seed fly, *Agromyza lantanae* Froggatt.

Kelisia paludum.—Mr. Swezey exhibited this little Delphacid, collected by him at Honaunau, Hawaii, August 13, 1919. Quite a series were collected at the time from a low sedge in a brackish place at about sea-level. The specimens had recently been determined by Mr. Muir. It is the first record on any other of the Hawaiian Islands except Oahu and Laysan.

Azya luteipes.—Mr. Swezey reported observing this lady beetle very abundant on a hau tree at the sea coast south of the Magnetic Station at Sisal, Oahu, January 29, 1922. A score or more could be seen at one time resting on the under side of the leaves of an isolated tree. He had never seen so many of this lady beetle before.

Chrysopa sp.—The immigrant lace-wing fly, which has been known the past two years on Oahu, was reported by Mr. Swezey as being very numerous on wiliwili trees on the Ewa coral plain south of Sisal. Their cocoons were most abundant, being found on the leaves, and also in the opened pods, many of which were hanging on the tree. Two to six of the cocoons were found together in some of the pods. A few larvae were also seen, and an adult has issued from the cocoons brought in, which proves the identity of the insect. *Pseudococcus virgatus* was present and had probably been the food of the insect.

North American Trypetidae.—Mr. Bryan exhibited specimens from this family with the following note: In order to have authentic specimens of *Eutreta sparsa* Wied. to compare with our lantana gall-fly, several mainland entomologists were appealed to. A series of ten specimens were received at the Bishop Museum from Dr. C. W. Johnson, Dr. W. E. Britton, and the United States National Museum, the specimens having been collected in Massachusetts, Connecticut, White Mountains, North Carolina, and California.

Dr. Johnson forwarded also a collection of typical eastern Trypetidae, with notes as follows: "*Eutreta sparsa* Wied. infests *Solidago,* forming swellings on the new shoots near the ground. The galls are figured in Thompson's 'Illustrated Catalogue of American Insect Galls,' p. 55, pl. 10, fig. 315. I enclose a California specimen. The western examples seem to differ somewhat from the eastern, and I sometimes wonder if they are really the same. *Eutreta diana* O. S. form galls on *Artemesia.* In the allied genus *Eurosta,* two closely related species will form very different galls or attack two species of plants. *Eurosta solidaginis* (Fitch) forms a large, globose gall on the stalks of *Solidago,* far above the ground. *Eurosta reticulata* Snow makes an elongate gall at the base of new growth. *Eurosta comma* (Wied.) makes a peanut-like gall on the roots of *Solidago rugosa. Eurosta elsa* makes about the same shaped galls on the roots of *Solidago juncea,* according to Daecke, Ent. News, v. XXI, p. 341, pl. 10, 1910."

In addition to specimens of these species, Dr. Johnson forwarded to the Museum specimens of *Straussia longipennis* (Wied.); *Acidia fratria* (Loew); *Oedaspis atra* Loew; *Rhagoletis pomonella* (Walsh), the apple maggot; *Aciura insecta* (Loew); *Icterica seriata* (Loew); *Tephritis albiceps* Loew; *Euaresta bella* (Loew); and *Trypeta palposa* Loew.

Mr. W. H. Cowdry, a visitor, made a few remarks. He stated that, although he had not attended an entomological meeting for fifty years, he was one of the first members of the Entomological Society of Canada. He had been to North China collecting botanical specimens, and found that the lack of forests there made the number of species of insects very small.

MARCH 2, 1922.

The 197th meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association, with Vice-President Fullaway presiding. Other members present were Messrs. Bissell, Bryan, Giffard, Illingworth, Muir, Rosa, Swezey, Timberlake, Wilder, and Willard.

The minutes of the previous meeting were read and approved.

PAPERS.

* **"Some of the Early References to Hawaiian Entomology."**

BY J. F. ILLINGWORTH.

EXHIBITS.

Stomatoceras hakonense Ashmead.—Mr. Timberlake exhibited two females of this species, which were collected by Mr. Whitney in a log from Japan during the course of his quarantine work. The specimens had apparently crawled into crevices of the log to hibernate, and their discovery after the log reached Honolulu is another illustration of the many ways that insects may be widely distributed by commerce.

Eutreta sparsa and *Eutreta xanthochaeta*.—Mr. Muir exhibited mounted genitalia showing the distinctive characters of these two flies.

Plagithmysus perkinsi Sharp.—Larvae of this beetle taken in *Myoporum sandwicense* in the region of the volcano in August, 1920, were brought to Honolulu in the wood and kept until February, 1922, when three specimens emerged, which were exhibited by Mr. Giffard. One was a perfect specimen, and another partially so, portions of the elytra having been eaten by the ant, *Pheidole megacephala*. The third specimen was quite eaten by ants, excepting one elytra and part of one hind leg.

Cane-borer caught by English sparrow.—Mr. Swezey reported having observed an English sparrow fly up and catch something on the wing, and take it to the ground to eat it. He succeeded in frightening away the sparrow and secured the remains of its feast, which proved to be an adult cane-borer beetle. Score another for the sparrow!

Heliothis obsoleta.—Mr. Swezey exhibited two moths reared from caterpillars found feeding on the blossoms of *Sida cordifolia* at Kaimuki, January 31, 1922. Ten of the caterpillars were found, but eight of them yielded parasites instead of moths, giving 80 per cent parasitization. Twenty-seven of the parasites, a Tachinid fly (*Frontina archippivora*), issued February 16-23. The moths issued February 24 and 28.

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* Withdrawn from publication.

The caterpillars of this moth are known as the cotton boll worm and corn ear worm in the Southern States; but in Hawaii they have not been recorded as injurious to these plants. Mr. Swezey reported that he tried the above caterpillars on green sweet corn and the corn was voraciously eaten by them. It is not understood why corn in the field has not been reported attacked by these caterpillars. The fact that they are so highly parasitized as above, indicates that they are sufficiently controlled by the Tachinids. No doubt the eggs are also somewhat attacked by *Pentarthron flavum*.

Gitonides perspicax Knab and *Titanochaeta ichneumon* Knab. —Mr. Swezey mentioned for record that these two flies had been described by Knab in Ins. Inse. Menstruus in 1914 from specimens sent him by Swezey. These had escaped being entered in Hawaiian literature.

Monopis meliorella (Walk.) and *Crypsithyris enixa* Meyrick. —Mr. Swezey exhibited these two moths which he had had determined by Mr. Meyrick, from specimens sent him recently. They had been collected in Kaimuki by Timberlake and Swezey, and are immigrants of which this is the first record.

Megastigmus sp.—Mr. Fullaway reported the capture, February 13, 1922, on the window of the laboratory at Government Nursery of a species of *Megastigmus*. Some of the species of this genus of Chalcid flies are seed-eating in the larval state.

Introduced Staphylinid.—Mr. Fullaway reported also the recovery on February 12, 1922, at Moanalua Dairy of the Staphylinid, *Creophilus erythrocephalus*, introduced by Mr. Illingworth from Australia in September, 1921, and since multiplied and distributed in the Territory.

Recently determined Coleoptera.—Mr. Fullaway also reported receiving the following identifications of introduced Coleoptera from Mr. G. E. Bryant of the British Museum.

Carabidae.

Bembidium sp.

Perigona nigriceps (Dej.).

Hydrophilidae.

Cercyon sp.

Trogositidae.

Lophocateres pusillus (Klug).

Cleridae.

Thaneroclerus buqueti (Lefèvre).

APRIL 6, 1922.

The 198th meeting of the Hawaiian Entomological Society was held at the usual place, and was presided over by Vice-President Fullaway. Other members present were Messrs. Bissell, Bryan, Ehrhorn, Giffard, Illingworth, Muir, Rosa, Soon, Swezey, Timberlake, and Willard. Mr. N. H. Cowdry was a visitor.

The minutes of the previous meeting were read and approved.

PAPERS.

"The Insect Fauna of Hen Manure."

BY J. F. ILLINGWORTH.

"On the Classification of the Fulgoroidea (Homoptera)."

BY F. MUIR.

NOTES AND EXHIBITIONS.

Diocalandra taitensis.—Mr. Bissell exhibited the pupal chamber and channels of a beetle, which were made in the husk of a dry coconut, and were evidently the work of *D. taitensis.* He stated that this coconut had been found at the home of Mr. Charles H. Bellina on Waialae Bay, April 2, 1922. This beetle has been previously found in the Hawaiian Islands only on the island of Hawaii, and this record would indicate that it is now on the island of Oahu.

Allograpta obliqua.—Mr. Swezey reported finding this new immigrant Syrphid fly abundant in the Hamakua district of Hawaii in March, 1922. Specimens were secured in several places: Honokaa; on hibiscus at the manager's house at Paauhau; and along roads where there was guava and lantana, 500 to 1000 feet elevation at Ookala.

Xiphidiopsis lita.—Mr. Swezey reported seeing four speci-

mens of this new Locustid in the clubhouse at Olaa, March 13, 1922. This indicates that it is becoming numerous outside of Hilo, where it has been known for three years, Olaa being about eight miles from Hilo. He also reported that Matthias Newell had told him of finding a male at light in Hilo. This is the first time the male has been observed, although the females have been seen by scores at lights at the Hilo Hotel.

Anisolabis eteronoma.—Mr. Swezey reported finding this large earwig common in cane fields on Hawaii in March, 1922. It was usually under trash, but was also found in the soil while digging for wire worms. They were found at Hilo Sugar Company, Laupahoehoe, and Honokaa. At the latter place they were also found in a rotten log above the cane fields at an elevation of about 2000 feet.

Exillis lepidus.—This Anthribid was found very abundant in dead Kukui twigs at Kaimuki by Mr. Swezey, March 15, 1922. The larvae were feeding in the pith of the dead twigs. A few pupae were found, and one had matured already, thus demonstrating what the insect was.

Araeocerus fasciculatus.—Mr. Swezey reported on the dissection of eggs from a female of this beetle, and that they agreed with the description given of them by Mr. R. T. Cotton in Journal of Agricultural Research, XX, No. 8, p. 607, 1921. They were different from the description given by Mr. Swezey in Proc. Haw. Ent. Soc., IV, No. 3, p. 452, 1921. This latter description was from eggs that Mr. Swezey had found, and surmised them to be those of *A. fasciculatus* from the circumstances of finding, and the fact that there was no other known species of beetle to which they could be referred. Now it is certainly known that the aforementioned eggs belong to something else, and just what, remains to be discovered.

Lasioderma serricorne.—The cigarette beetle was reported by Mr. Swezey as having been reared from a larva feeding in the pulp of a dried litchi nut handed to him by Dr. Lyon.

Agromyza lantanae.—Mr. Swezey reported results of germination of lantana seeds that had been infested with maggots of this Agromyzid. From 100 infested seeds, retained until after emergence of flies, and then planted December 20, 1921, between

February 18 and April 5, 1922, eighty-two seedling plants were obtained.

As a check, 100 non-infested seeds were similarly planted, and ninety-five seedlings were secured. This is a further demonstration of the fact that the Agromyzid does not thoroughly destroy the embryos of the lantana seeds.

Note on fumigation with carbon bisulphid. — Mr. Ehrhorn exhibited a dry limb of *Paulownia imperialis* from Japan, which was imported for use as floats for fish-nets. Upon its arrival, this limb contained a nest of ants, and was fumigated with carbon bisulphid. He called particular attention to the fact that the hollow center of the limb, used by the ants as a nest, had a very small entrance hole at one end, through which the carbon bisulphid fumes successfully penetrated and killed all of the ants during an exposure of forty-eight hours.

*An undetermined fly.**—Mr. Illingworth reported the finding of a new fly at Kaimuki. He noticed them flying in a group like Syrphid flies, but he had not yet established their identity.

MAY 4, 1922.

The 199th meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association, with Vice-President Fullaway in the chair. Other members present were Messrs. Bissell, Crawford, Bryan, Ehrhorn, Giffard, Illingworth, Swezey, Timberlake, Rosa, Willard, and Williams.

The minutes of the previous meeting were read and approved.

Mr. Swezey reported the receipt from the printers, of the new indexes for Vols. I and IV of the Proceedings.

PAPERS.

"Halobates in Hawaii (Hemiptera)."

BY E. H. BRYAN, JR.

NOTES AND EXHIBITIONS.

Tinea pelionella.—Mr. Swezey exhibited a specimen of this

* Later determined by Dr. Aldrich as *Limnophora arcuata* Stein. [Ed.]

Tineid reared from a larval case on an old woolen cap, April 7, 1922. Several of the cases were found, four of them containing larvae. Moths reared from these April 27 to May 1, 1922. This moth was recorded in the Fauna Hawaiiensis, but collections here contain no specimens. The present specimen belongs to this species.

Carabid new to Hawaii.—Mr. Timberlake exhibited a small Carabid beetle captured by Mr. Muir at Puuloa, Oahu, April 10, 1922, on the ground among sugar-cane. It is an immigrant not heretofore seen here.

Glyptocolastes bruchivorus.—Mr. Bissell exhibited specimens of this Bracconid, reared from *Mylabris sallaei* in *Acacia farnesiana,* collected on Ewa coral plain, April 21, 1922. This is the first recovery of this Bruchid parasite, since its introduction from Texas in the summer of 1921.

Nut grass borers.—Mr. Williams mentioned two borers in nut grass (*Cyperus rotundus*), taken in the Philippines. One of the borers is the larva of a Tortricid moth, determined by Mr. Swezey as belonging to the genus *Bactra.* The other is the larva of a small beetle, apparently related to the "bill bugs" in the United States. Both species of larvae bore in the stems and the corm, but are not an effective check on the nut grass in the Philippines.

Scutigera straba (Wood), The Hawaiian house centipede.—Mr. Bryan gave the following synonymy and note on this centipede:

Cermatia straba Wood, Jour. Acad. Nat. Sci. Phila., (2), V, p. 11, 1862.

Scutigera straba Silvestri, Fauna Hawaiiensis, III, p. 323, 1904.

A specimen was captured in the Bishop Bank, April 29, and presented to the Bishop Museum by Mr. Garvie, teller. It fits the description of this, the only *Scutigera* recorded from Hawaii, a translation of the description of which follows:

"Ferruginous Cermatia (Scutigera); single median line; head broad, densely, minutely punctated, and appendages sparsely pilose; broad and long longitudinal depressions in the middle and

on both sides (of the head), the one curved, before the eyes, the other transverse, indistinct, between the eyes; the scuti roughened with small spines and minute, close punctures, scarcely scaly, posterior edge emarginate, with the margins strongly elevated, spiny and crenulate; the legs ferruginous, first joint of the metatarsus equal in length to the following seven."

It is closely allied to *Scutigera forceps* Raf., the mainland house centipede, recorded in U. S. Dept. Agr. Circ. 48.

JUNE 3, 1922.

The 200th meeting of the Hawaiian Entomological Society was called to order at 2:30 p. m. by Vice-President Fullaway, at the usual place. In the absence of the Secretary, Mr. Timberlake was appointed by the Chair to act as Secretary pro tempore. Other members present were Messrs. Bryan, Crawford, Ehrhorn, Giffard, Illingworth, and Rosa.

The minutes of the previous meeting were read and approved.

PAPERS.

"New or Little-Known Crane-Flies from the Hawaiian Islands."

BY CHARLES P. ALEXANDER.

(Presented by Mr. Bryan.)

NOTES AND EXHIBITIONS.

Dolichopodidae.—Mr. Timberlake exhibited a small collection of local Dolichopodidae. Eight species are apparently of immigrant origin and of these, three belong to *Psilopus* (*patellifer* Thoms., *pachygyna* Macq., and *pallidicornis* Grimsh.), and one each to *Hydrophorus, Medeterus, Asyndetus, Dolichopus,* and *Hypocharassus.* The recently described *Dolichopus exsul* Aldrich (Proc. U. S. Nat. Mus. 61, Art. 25, p. 15, May, 1922) is very abundant in favorable places in the mountains such as Pauoa flats, on Tantalus, and also has been taken in Honolulu. It is widely distributed throughout the Islands and has been collected on Kauai, Oahu, Maui, Molokai, and Hawaii. Of the endemic species about twelve were shown, none of which agrees with those described by Grimshaw.

Nesopimpla naranyae.—Mr. Timberlake called attention to a recent paper by Cushman (Proc. U. S. Nat. Mus. 61, Art. 21, p. 9, May, 1922) in which *Itoplectis immigrans* Timb. is synonymized with *Nesopimpla naranyae* Ashmead, which was described from Japan in 1906. The parasite may possibly be one of those introduced by Koebele in 1896, from Japan, and was first collected on Oahu by Dr. Perkins in 1901.

Syagrius fulvitarsis.—Mr. Fullaway reported the discovery of the fern weevil on Maui by Mr. C. S. Judd, Territorial Forester, on May 22, 1922. It was found on the Amaumau fern on the lower side of Nahiku ditch between Makapipi and Hanawi streams for a distance 300 feet along the ditch, and also in one spot at Kapaula near the Nahiku camp. Later, the infestation was found to extend about a mile between the Government road and the ditch, and to points above the ditch.

A discussion followed concerning the probable means of interisland dispersion of the fern weevil, with the general agreement that it must have been carried by travelers to Hilo from Honolulu, and probably from Hilo to Maui in potted ferns, fern leis, etc.

JULY 6, 1922.

The 201st meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association. Owing to the absence of the president and vice-president, Mr. Swezey was chosen as chairman. Other members present were Messrs. Bissell, Bryan, Ehrhorn, Illingworth, Rosa, Timberlake, Wilder, and Willard. Mr. R. Ewart was a visitor.

The minutes of the previous meeting were read and approved.

PAPERS.

"Notes on Diptera."

BY E. H. BRYAN, JR.

Mr. Bryan presented also the following paper, "Undescribed Species of Australasian and Oriental Crane-Flies," by Charles P. Alexander.

Xanthoencyrtus fullawayi.—Mr. Timberlake reported the discovery of this parasite of *Pseudococcus calceolariae* Maskell, on Oahu, two females having recently appeared in a collection of the host made in upper Manoa Valley in June, 1922, by Swezey and Fullaway. This species has formerly been known only on Hawaii.

Trypoxylon philippinensis.—Mr. Swezey reported that he had recently received the identification of this wasp from specimens sent to Mr. S. A. Rohwer of the United States National Museum. This *Trypoxylon* was first collected in Honolulu by Dr. H. L. Lyon, December 6, 1913. It is first recorded in Proc. Haw. Ent. Soc., III, p. 66, 1915, where Mr. Swezey reports having found its nest in folds of corrugated paper in a packing-box at Kaimuki, October, 1914. Specimens reared from this nest are reported on page 90 of the same publication. On page 458 is mention of a nest in glass pipette in chemical laboratory which was of this wasp. It was first reported in Hilo, Hawaii, by Swezey in September, 1918, recorded in Proc. Haw Ent. Soc., IV, No. 1, p. 75, 1919. On page 458 of the same volume Mr. Williams reported the finding specimens of the same *Trypoxylon* in the Experiment Station, H. S. P. A. collection, that were collected in the Philippines (Williams) and Hongkong (Terry).

Sisyrophyta gomphias.—Mr. Swezey exhibited a specimen of this moth reared from a caterpillar collected by Mr. Ehrhorn on a *Pisonia* tree on Mount Tantalus, April 30. He stated also that he had reared two moths from pupae found in soil at the base of a *Bobea* tree in the forest above the cane fields at Kukaiau, Hawaii, May 30, 1922. The food plant of this species had not previously been known. Apparently it is not confined to one tree.

Micromus vinaceus.—Mr. Swezey reported the recovery of this introduced Australian Hemerobiid at Paauilo, Hawaii, May 29, 1922; Niulii, Hawaii, June 6, 1922; Pololu Valley, Hawaii, June 8, 1922; and Opaeula, Oahu, April 10, 1921. Mr. Bryan has collected it recently on the Na Pali coast of Kauai.

Polycaon stoutii.—Mr. Swezey exhibited a specimen of this

large Bostrychid beetle sent in by Mr. William Searby, May 22. It had issued from an oak table. Another beetle had issued from this table a short time previously and had been destroyed. This is a California beetle which attacks live oak, maul oak, eucalyptus, and almond. It has not been taken previously in Hawaii.

Chaetospila elegans.—Mr. Swezey reported finding this parasite in a small package of sorgham seed infested with *Calendra oryzae* at his house in Kaimuki. The package was what was left from planting and had been undisturbed for about six weeks. When examined October 28, it was found to be badly infested with the weevils, many adults being present. Sixteen adults of the parasite were secured; also a brachypterous Anthocorid bug not seen before.

Holcobius glabricollis.—Mr. Swezey exhibited this Anobiid and reported that fourteen beetles had issued from branches of dead koa tree brought in by Mr. Williams from the Manoa cliffs trail, Tantalus, August 29, 1920. In the Fauna Hawaiiensis, this beetle is recorded as scarce, a very few specimens having been taken on Haleakala, Maui, by Mr. Blackburn, and on Oahu by Dr. Perkins. In both instances on koa trees. Possibly it is attached to this tree.

Chrysomyia dux Esch. in Australia.—Mr. Bryan exhibited a male specimen of this Muscid fly, which was captured at Port Hacking near Sydney, November 4, 1914, by Musgrave; and which was loaned to the Bishop Museum for examination by the Australian Museum at Sydney.

Holocompsa fulva Burm.—Mr. Bryan exhibited another specimen of this little roach, which was captured in Hilo on dry moss by Mr. Matthias Newell. Mr. Illingworth stated that Mr. Newell had observed this roach as common about Hilo for a number of years.

Diocalandra taitensis Guer.—Mr. Bissell exhibited a specimen of this coconut weevil which was bred from the base of a dry coconut leaf from the grove of Mr. Charles H. Bellina at Kuliouou, Oahu. This leaf was collected the latter part of April, 1922, and the beetle emerged during June, being the first specimen collected on Oahu.

Culex sp.—Mr. Ehrhorn called attention to specimens of a mosquito which he collected at Kahala. He reported that this species does not make any sound when attacking at night, whereas *Culex quinquemaculata* does make a sound; and inquired if any member of the society had made the same observations.

Importation of birds.—Mr. Ehrhorn reported that the Board of Agriculture and Forestry had permitted the landing of six peewees for liberation on the Parker Ranch on Hawaii. He stated that these birds included in their diet certain soft snails in which the liver fluke passes part of its life cycle.

SEPTEMBER 7, 1922.

The 202d meeting of the Society was held in the usual place, with Vice-President Fullaway presiding. Other members present Messrs. Bissell, Crawford, Giffard, Rosa, Swezey, Timberlake, and Wilder. In the absence of the Secretary, Mr. Swezey was appointed secretary pro tem.

Minutes of the previous meeting were read and approved.

PAPERS.

*** "A Study of the Male Genitalia of the Hawaiian Cixiidae (Homoptera). Part I. Iolania Kirkaldy."**

BY WALTER M. GIFFARD.

NOTES AND EXHIBITIONS.

Exillis lepidus Jordan.—Mr. Fullaway reported that he had recently received a letter from Dr. K. Jordan giving this as the name for this immigrant Anthribid beetle. It had recently been described in The Entomologist, Vol. LV, p. 152, 1922. It is the insect mentioned as "A New Anthribid" on page 273, Vol. III of Proc. Haw. Ent. Soc., 1917; and as "*Lawsonia* sp.," Proc. Haw. Ent. Soc., V, pp. 38 and 75, 1922.

Pheidole megacephala.—Mr. Crawford reported the apparent scarcity of this ant during the past eight months in Manoa Valley. It has been replaced by the tiny yellow ant, *Plagiolepis*

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* Withdrawn for publication elsewhere. [Ed.]

exigua. But lately *Pheidole* has again become prevalent, and Mr. Crawford wondered if the present greater abundance of the house-fly was connected with the previous scarcity of the ant, as the latter is known to have some control of the house-fly maggots. Mr. Giffard also had noticed the prevalence of one or another of these ants at various times. Mr. Timberlake mentioned similar observances, and that at one time when he was living on Lunalilo Street, the guinea ant was the most prevalent. Mr. Fullaway reported the presence in great abundance of the yellow ant on mealy-bug material used in breeding lady-beetles, but that it caused no interference or injury, it merely living on sweets—the honeydew in connection with the mealy-bugs.

Synonymy of the Fuller's Rose Beetle.—Mr. Muir, at present in England, sent the following note on the synonymy of this beetle: In Bull. Soc. Ent., France, 1922, No. 8, p. 100, Hustache points out that our Fuller's rose beetle (*Aramigus fulleri* Horn) is the same as *Pantomorus godmani* (Crotch). Both Mr. Chapman and Dr. Marshall have examined Crotch's type and agree with Hustache. Our species must, therefore, be known in future as *Pantomorus godmani* (Crotch). The following synonymy and distribution is given by Hustache:

Pantomorus godmani (Crotch).

Asynonychus godmani Crotch, Proc. Zool. Soc. Lond., 1867, pp. 388, 389, pl. 23, fig. 9.

Aramigus fulleri Horn, Proc. Am. Phil. Soc., XV, p. 94, 1876.

Pantomorus olindae Perkins, Fauna Hawaiiensis, I, p. 130, 1900.

Pantomorus fulleri Champion, Biol. Cent. Amer., IV, 3, p. 333, pl. 15, fig. 19, 1911.

Naupactus ovulum Iek. in litt.

? *Naupactus subvittatus* Fairm. and Germ., Col. Chili, II, p. 7, 1861.

Distribution: California, Mexico, Brazil, Chili, Azores, Portugal, Sicily, and Hawaiian Islands. It is considered of American origin, and was evidently introduced into the other regions named.

Mr. Fullaway called to attention that this synonymy is given by Champion in the Entomologist's Monthly Magazine, (3) VIII, p. 161, 1922.

Perkinsiella saccharicida and *P. insignis.*—Mr. Muir sent this

note on these leafhoppers, from examination of material in the British Museum: In looking through unworked material at the British Museum, I found three specimens of *Perkinsiella* Kirk. Two of the specimens are *P. saccharicida* Kirk., one from Merebank, Natal (C. P. V. D. Merwe, I-2-18), and the other from Mauritius (J. E. M. Brown). The third specimen is *P. insignis* (Dist.) from Accra, Gold Coast (J. W. Scott Macfie, November, 1920). It is possible that *P. saccharicida* has been taken to Mauritius and Natal with sugar-cane. As no damage due to this insect has ever been reported from those regions, we must presume that parasites keep it in check.

Allograpta obliqua (Say).—Mr. Giffard reported that in July and August he captured a large series of both sexes of this Syrphid fly flying over the flowers of Sweet Alyssum at twenty-nine miles, Olaa, near Kilauea, Hawaii. This fly was recorded on February 5, 1920, by Timberlake (Proc. Haw. Ent. Soc., IV, 3, p. 456, 1921) as a new immigrant on Oahu. In October, 1920, Swezey also reported it from Kauai. It has not yet been reported from other islands than the above. Other Syrphids taken at the same time at or near Kilauea were: *Volucella obesa* Fab., *Eristalis tenax* L., *E. punctulatus* Macq., and *Xanthogramma grandicorne* Macq. *E. tenax* was very abundant everywhere in the neighborhood, but the others were only seen occasionally.

Scotorythra hyparcha Meyr.—Mr. Giffard remarked on the overabundance of this nocturnal moth at lights in the Kilauea region for the past four or five months. The verandahs and porches of the Volcano House and residences in the neighborhood have been overrun by this moth, possibly 90 per cent of the number seen nightly being males. At the hotel, the nightly flight was so annoying to guests that the servants were called upon to use the vacuum cleaner to sweep the ceilings and walls free of these pests. During twelve years and frequent visits he had never seen such an invasion of that or any other species of moth as occurred this summer.

Kelisia paludum.—Mr. Giffard reported the collecting of a large series of both sexes and nymphs of this Delphacid on a patch of *Juncus* sp. near the beach at Naapoopoo, Kealakekua,

S. Kona, Hawaii, August 1, 1922. The male genitalia agree perfectly with the Oahu form, but the coloration of this Kona form is much darker than those from Oahu, and is nearer in color to the Fijian form described by Muir. Mr. Swezey reported having collected this same Delphacid in August, 1919, on a small swamp sedge at Honaunau, which is only a few miles further south than where Mr. Giffard's specimens were collected.

Mediterranean fruit-fly.—Mr. Wilder exhibited some small green apples grown on a tree near the Territorial prison at Kalihi, which he suspected were infested with the Mediterranean fruit-fly. So far nothing but Drosophilids had been bred from them. Mr. Crawford mentioned that there appeared recently in a California horticultural journal the report that larvae and pupae of the Mediterranean fruit-fly had been found in a package containing avocadoes, but marked "groceries," that had been received at Los Angeles through the mail from Honolulu. This was followed by a general discussion on fruit-flies and the methods of quarantine against them prevalent in California.

Pink Boll-worm.—Mr. Fullaway stated that what was apparently this pest had been reported by Simmonds in Fiji.

Zoraptera sp.—Mr. Fullaway reported collecting this remarkable insect at Kokee, Kauai, where Mr. Swezey first discovered it last year. He secured what he took to be a winged form of it.

Pontia rapae.—Mr. Swezey reported seeing one or more cabbage butterflies flying on board the steamship "Wilhelmina," September 4 and 5, being the last two days of the voyage of the steamer from San Francisco to Honolulu. A butterfly was seen on four different occasions, but it could not be determined whether there were that many different individuals or if it was the same individual observed that many times. As there were crates of cabbages on the deck of the steamer, it is inferred that the butterflies seen had issued from chrysalids that were among the cabbage leaves. This demonstrates how some of the immigrant insects could have arrived, and it is very probable that the Syrphid fly, *Allograpta obliqua,* came in just this way, as its larvae feed on plant lice, and cabbages are often infested with them.

OCTOBER 5, 1922.

The 203d meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association. Vice-President D. T. Fullaway occupied the chair. Other members in attendance were Messrs. Bryan, Crawford, Ehrhorn, Illingworth, Rosa, Swezey, Timberlake, and Willard.

The minutes of the previous meeting were read and approved.

It was with deep regret that the members learned of the death, on August 27, 1922, of Dr. David Sharp, of London, England, who was an honorary member of this society.

Upon motion of Mr. Swezey, it was unanimously voted to appoint Mr. Giffard as a committee to draft proper resolutions on the death of Dr. Sharp.

PAPERS.

"Insects from the Summit of Mauna Kea."

BY E. H. BRYAN, JR.

"Review of Dr. Heinrich Karny's Der Insektenkorper und seine Terminologie."

BY E. H. BRYAN, JR.

NOTES AND EXHIBITIONS.

Diptera. — Dr. Illingworth gave further notes on Diptera, explaining corrections by Dr. Aldrich and Major Patton in the determinations of several species of Diptera mentioned in a paper, entitled "Notes on Diptera Occurring in the Hawaiian Islands," and which has been previously recorded in these Proceedings.

Diocalandra taitensis (Guern.)—Mr. Ehrhorn reported the occurrence of this coconut weevil at Lahaina on the island of Maui. This information came from Mr. George Compere, who found this insect in a coconut sent from Lahaina to San Francisco by mail. Mr. Compere found many holes like shot-holes in the husk, and cutting into the husk, found larvae, pupae, and adults, a sample of which he sent to Mr. Ehrhorn.

Rhinoceros beetle from Guatemala.—Mr. Swezey exhibited a

monstrous horned beetle handed him by Mr. William Weinrich, who had collected it on a tree in Guatemala in August of this year.

Oligota sp.—Mr. Swezey exhibited a tiny Staphylinid beetle probably of this genus, which he had found feeding on the sugar-cane leaf-mite and its eggs in the cane fields of Oahu Sugar Company, and also at the Sugar Planters' Experiment Station grounds. The larvae were also found feeding on the mites. This is apparently the first record of this immigrant beetle in the Islands. A similar beetle occurs feeding on red spiders in California. It may turn out that this is the same species. The mite that they were feeding on here is *Tetranychus exsiccator,* the cane leaf-mite occurring in Java. Apparently this has never been recorded in Hawaii, though it has been known for a long time that mites were occasionally found on cane-leaves.

Ereunetis flavistriata.—Mr. Swezey mentioned that, while in San Francisco in August at the Plant Inspector's office, he inquired about the *Hyposmocoma* sp., which had been reported as occurring on coconuts from Honolulu, as per printed reports in the California Monthly Bulletin. A more recent identification had been made by Mr. Busck as *Ereunetis* sp. On being shown a specimen of the moth concerned, Mr. Swezey was able to identify the species as *Ereunetis flavistriata,* the sugar-cane budmoth, whose larvae are found also on banana bunches, pineapples, and various other plants, chiefly feeding on the dead tissues.

Heterospilus prosopidis.—Mr. Swezey reported rearing this Braconid quite plentifully from *Bruchus chinensis* in pigeon peas at Kaimuki, September 16, 17, 1922. The peas had become infested by the bruchids while still on the bushes. Males predominated in those reared, there being nine males and three females.

Pediculoides ventricosus.—Dr. Illingworth stated that kerosene was very helpful in relieving the irritation caused by the bites of this mite on the bodies of human beings.

Pseudaphycus sp.—Mr. Fullaway exhibited specimens of this Encyrtid, introduced from Mexico in April and May, 1922. It

is a primary parasite of *Pseudococcus nipae* and has already become established here.

Anagyrus antoninae.—Mr. Timberlake exhibited a small series of this species from Japan, consisting of two specimens from Nagasaki collected by Mr. T. Ishii, and three specimens collected by Mr. C. P. Clausen, California State Insectary, No. 1261a.

Magachile.—Mr. Timberlake exhibited specimens of *Megachile fullawayi* and *M. timberlakei* collected at Kaimuki, September, 1922, at flowers of *Cosmos.*

Pleistodontes imperialis.—Mr. Timberlake reported that this fig-wasp, caprifier of *Ficus rubiginosa,* has become established from specimens liberated in January, 1922. A few specimens of the wasp were reared from a fig collected by Dr. H. L. Lyon on July 16 from a tree at the Federal Experiment Station grounds in Honolulu.

NOVEMBER 2, 1922.

The 204th meeting of the Hawaiian Entomological Society was held at the usual place, and was presided over by Vice-President D. T. Fullaway. Nine other members were present, as follows: Messrs. Bissell, Bryan, Ehrhorn, Giffard, Illingworth, Rosa, Swezey, Timberlake, and Willard.

The minutes of the 203d meeting were read and approved.

Mr. Giffard, chairman of the committee on finances, reported that the Hawaiian Sugar Planters' Association had voted to donate to the society the sum of $300 to meet the deficiency in the cost of printing the Proceedings for the year 1921.

Upon motion of Mr. Giffard, it was unanimously voted that the Secretary write the Hawaiian Sugar Planters' Association, conveying to them the thanks and appreciation of the society for their continued support.

In response to a request from Mr. Giffard (appointed at previous meeting), Mr. Crawford was appointed to assist him in drafting a resolution on the death of Dr. David Sharp. This committee submitted the following resolution:

"The Hawaiian Entomological Society feels with deep regret

the loss it has sustained in the passing of a distinguished honorary member, Dr. David Sharp. But much greater, however, is the loss to Entomological Science which has been so much advanced by the devoted work of this great man. To the loved ones who survive Dr. Sharp, this Society extends its sincerest sympathy and Aloha."

Upon motion of Mr. Swezey, it was unanimously voted that this resolution be adopted and a copy sent to the bereaved widow.

Mr. Fullaway stated that Mr. Muir had informed him by letter that he would later on write up an obituary of Dr. Sharp.

PAPERS.

"Records of Introduced Beneficial Insects."

BY O. H. SWEZEY.

"A List, With Notes, of Insects Found at Waimea, Hawaii, in June, 1922."

BY J. F. ILLINGWORTH.

"House-Flies."

BY J. F. ILLINGWORTH.

NOTES AND EXHIBITIONS.

Pheidole megacephala Fabricius. — Mr. Giffard observed a swarm of queens and males of this ant in flight over his premises on Keeaumoku Street about 6:30 in the morning of one day in October. He stated that the swarm was about four feet wide and forty to fifty feet long. Mr. Ehrhorn stated that he had observed smaller swarms of these ants on several occasions, and that they usually swarmed after a rain-storm.

Anicetus annulatus.—Mr. Timberlake exhibited one specimen of this species reared by Mr. H. Compere from *Coccus hesperidum* on *Aralia,* taken in quarantine at San Francisco from the steamship "Taiyo Maru." Also two females from *Coccus hesperidum* collected at Sacramento, California, in 1912; a small series collected by Mr. Muir at Chin San, Macao, China, in December, 1906; and a few from China reared by Mr. Koebele under his number 1225. The species was described in 1919 from specimens collected on Oahu and Kauai.

Labels.—Mr. Bryan called attention to the method of making insect and locality labels by photographing sheets of paper upon which the desired information had been typewritten. He stated that he had found this method very satisfactory, where the number of labels desired was too small to pay for printing.

Micromus vinaceus.—Mr. Swezey exhibited cocoons of this introduced Hemerobiid, situated between ribs at base of papaia leaf, and reported that they were found there quite abundantly at the United States Experiment Station grounds.

Agrotis neurogramma Meyr.—Mr. Swezey exhibited a specimen of this Noctuid moth collected at light by Mr. Giffard at Kilauea, Hawaii, in August, 1922. This is only the second specimen of this moth that has been collected, so far as known. It was described in the Fauna Hawaiiensis on a single specimen collected at Kilauea by Dr. Perkins in August (the year not recorded in the Fauna, though it was probably 1895) and apparently none have been collected since until now.

Pantomorus godmani.—Mr. Swezey reported on the abundance of the eggs of this beetle in koa pods hanging on the trees on Sugar Loaf Mountain, October 29, 1922. Of fifty-five pods examined, forty-five had from one to seven batches of the eggs inside. There was a total of 103 batches. The pods had many perforations made by the larvae of the Tortricid which destroys most of the koa seeds. Apparently the beetles had oviposited inside the pods by inserting the ovipositor into the holes, as the egg-batches were always near these openings and in the place where a koa seed had been eaten.

Cylas formicarius.—Mr. Ehrhorn exhibited photographs of a basket of sweet potatoes, imported from Shanghai, China, and of cut-open individual potatoes, showing a very severe infestation by this sweet potato weevil. Sweet potatoes are imported as food from the Orient by the Chinese, but importations are less than they were six or eight years ago.

Urosigalphus bruchi Cwfd.—Mr. Bissell exhibited specimens of this Bruchid parasite, and reported that eleven individuals had been reared from Bruchidae in algaroba pods collected between September 21 and October 25, 1922. This parasite was introduced from Texas in July, 1921, and this is the first record of its recovery since its liberation at that time.

DECEMBER 7, 1922.

The 205th meeting of the Hawaiian Entomological Society was held at the experiment station of the Hawaiian Sugar Planters' Association, with Vice-President D. T. Fullaway presiding. Other members present were Messrs. Bissell, Bryan, Crawford, Ehrhorn, Giffard, Illingworth, Rosa, and Willard. Messrs. Syuti Issiki and Tadashi Okumi, Japanese entomologists from Formosa, were visitors.

The minutes of the previous meeting were read and accepted.

The treasurer's report, showing a cash balance on hand of $78.50, was accepted subject to the approval of Mr. Crawford, who was appointed auditor.

Officers were elected as follows for the year 1923:

President	F. Muir
Vice-President	O. H. Swezey
Secretary-Treasurer	H. F. Willard
Additional members of Executive Committee	D. L. Crawford W. M. Giffard

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*ANNUAL PRESIDENTIAL ADDRESS.

"Notes on the Mealy-Bugs of Economic Importance in Hawaii."

BY D. T. FULLAWAY.

PAPERS.

"Descriptions of Two New Mexican Species of Encyrtidae Introduced into Hawaii (Hymenoptera)."

BY P. H. TIMBERLAKE.

†"Review of the Hawaiian Genera Dyscritomyia and Prosthetochaeta, With Description of New Species (Diptera)."

BY E. H. BRYAN, JR.

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* In the continued absence of the president, H. T. Osborn, throughout the year (being on parasite exploration in Mexico), the vice-president, D. T. Fullaway, occupied the chair for the year and also presented the Annual Address. [Ed.]

† Withdrawn from publication. [Ed.]

"New Records, Identifications, and Synonymy of Diptera in Hawaii."

BY E. H. BRYAN, JR.

"Insects Attracted to Carrion in Hawaii."

BY J. F. ILLINGWORTH.

*** "A Study of the Male Genitalia of the Hawaiian Cixiidae (Homoptera). Part II. Oliarus Stal."**

BY W. M. GIFFARD.

NOTES AND EXHIBITIONS.

A new fly.—Mr. Fullaway exhibited a small fly, not previously known to occur in the Islands. It was taken on a windowpane of the quarantine room at the Government Nursery, and is supposed to have come into the room with cow manure. The fly has a pair of caudal hooks, is black with a white transverse band on the abdomen, and has white halteres. It appears to be close to the species of *Milichia* (Agromyzidae) represented here.

Coccus elongatus.—Mr. Ehrhorn exhibited a limb of a Cosmos tree heavily infested with this scale, which had been killed by a white fungus. He called attention to the varieties of fungi attacking Coccidae and other Homoptera here and on the mainland and stated that this limb showed an exceptional attack of fungus on *C. elongatus.*

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* Withdrawn from publication. [Ed.]

PAPERS PRESENTED DURING 1922.

On the Classification of the Fulgoroidea (Homoptera).

BY F. MUIR.

(Presented at the meeting of April 6, 1922.)

INTRODUCTION.

Stål has been justly styled the Father of Hemipterology, and the fourth volume of his Hemiptera Africana (1866) is still the foundation of the classification of Homoptera. Although the number of genera has increased greatly since then, yet the characters he employed in his classification of the fulgorids hold good for most cases today. The trouble has been that workers have disregarded his characters and placed genera in families where they should not be, and so they have broken down the family characters.

A contemporary of Stål's, F. X. Fieber, also laid us under a deep debt by his work. Although he based his work mainly on European species, it holds good today. In many ways he was more modern than Stål, especially in his specific work. His recognition of the value of the male genitalia for specific distinction placed the Delphacidae of Europe in a condition that no other method could have done. If we follow his lead and extend his work it will be to the advantage of Homopterology.

Another worker to whom we owe a debt of gratitude for the elucidation of the relationship of the families of Auchenorhynchous Homoptera is H. J. Hansen. His work[1] has shown the morphological distinctions between the different groups and has placed these divisions on a safe foundation. That I do not agree with him, in regarding the fulgorids as consisting of a single family, in no way implies that I do not appreciate or recognize his good work. His paper should be in the hands of every student of Homoptera.

Melichar has compiled monographs of seven of the families

Proc. Haw. Ent. Soc., V, No. 2, September, 1923.

[1] Entomologisk Tidskrift XI (1890), pp. 19-76, Pls. I, II. Partly translated by Kirkaldy, The Entomologist, April, 1900, p. 116, et seq. I have not used all of Hansen's characters and must refer the reader to his work.

of Fulgoroidea, viz., Flatidae,[1] Acanaloniidae,[1] Ricaniidae,[2] Tropiduchidae,[3] Dictyopharidae,[4] Issidae,[5] and Lophopidae.[6] By so doing he has placed all Homopterists under obligation. Workers may wish at times that he had been more critical in his treatment of some groups and had used more fundamental characters for his subfamilies and tribes, but this in no way detracts from our obligations to him for his great industry.

Kirkaldy died before he had matured his views. Had he lived I feel sure he would have eventually produced a classification worthy of his labors.

Many workers have added to the number of genera and species during the last decade, but in most cases their contributions to the broader aspects of classification of the fulgorids have not been great, and in some cases their work has been inimical through their having placed many genera into wrong families.

The present paper is but an incomplete resumé of what is at present known on the subject of the families of the fulgorids. If it enables younger workers to recognize them, work upon their better characterization and to arrange more adequately the genera which compose them, then it will have served its purpose. I also hope that it will convince workers that the divisions are distinct enough to be recognized as families. This latter has a practical as well as a theoretical bearing, for workers are often more careful to place their genera into the right family than they are to place them into the right subfamily. It would also have the advantage of enabling the Recorder to segregate the genera into families in the "Zoological Record" instead of lumping them all together.

I have also used some of the information that I have accumulated on the male genitalia. The characters found in these organs are without doubt the most valuable aids to specific work. Not only do they show the specific differences, but they

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[1] Ann. des K. K. natur Hofmus Vienna (1902).

[2] t. c. XIII (1898).

[3] Verh. Natur. Verin. Brun (1914).

[4] Abh. K. K. zool. bot. Ges. Wien VII (1912).

[5] t. c. (1906).

[6] Ann. Mus. Nat. Hist. Hung. XIII (1915).

indicate the specific relationship better than any other characters. They are also of value for generic purposes and, so far as I have observed, are of use in the separation of families. By the study of these organs I believe that we shall eventually have a much better idea of the relationship of the families than we have at present.

The female genitalia may have equally good characters, but my knowledge of these at present is too limited to allow me to generalize upon them. I hope to be able to do so at a later date. The only generalization I can make at present is the distinction between complete and incomplete ovipositors.

Among the Fulgoroidea some of the chief characters used for generic purposes are the shape of the head and thorax and the number and arrangement of the carinae upon them. These characters, I believe, are liable to independent origin in different species, and so some of our genera may have a polyphyletic origin. Some of the families as they now stand are also likely to have a polyphyletic origin. The further study of the male genitalia is likely to show this, and will lay the foundation upon which a more natural grouping of both species and genera is likely to be erected.

The Order Hemiptera.

The Order Hemiptera or Rhynchota forms a large, homogeneous, and monophyletic group of insects characterized by the shape, position, development, and function of the mouth organs. Although there exists some difference of opinion as to the minor details of the homologies of the head and mouth parts, the fact has been established by embryological studies that they are built upon a normal, mandibular type, and that the alteration takes place during the development of the embryo. It has also been shown that the mouth parts arise in a similar manner in both the Homoptera and Heteroptera.

The mandibles form long, thin setae; the maxillae during their development divide into two parts, one forming a long, thin seta and the other amalgamates with the head capsule; the labium is long and narrow, with its lateral edges curved upward, and meet together on the middle dorsal line, thus forming a split tube in which the setae rest. In the embryo the labium arises

as paired processes, which later on amalgamate; the evidence indicates that it represents the entire labium and not the palpi only. In many adult Heteroptera there are four divisions, which, by their position, are evidently homologous to the submentum, mentum, and ligula, the latter consisting of two segments which are probably the subgalea and the amalgamated paraglossa and lacinia. In *Belostoma* there is a pair of small, simple processes on the subgalea which are considered by some to represent the palpi. From the base of the mandibles a sulcus has sunk into the head running toward the antennae, and the head capsule has grown over the base of the mouth parts. This obscures the homologies. Although the order is very large and the head undergoes great changes in the various groups, yet the shape, arrangement, and function of the mouth organs remain more constant than in any other of the larger orders of insects.

By the character of the mouth organs the Hemiptera are distinctly separated from all other insects. The Thysanoptera come nearest to them, but they are so distinct that they can have no direct phylogenetic connection, only an indirect one, through a remote common ancestor from which both may have evolved along somewhat similar but distinct lines. The Psocidae possess a semi-free maxillary rod, which may be the starting point of the maxillary seta, but they can only be related through a very distant common ancestor. The similarity between the wings of Psocidae and Psyllidae is due to convergence or parallel development, and has no phylogenetic significance. If the Mallophaga have any relationship to the Anoplura, then the latter can have no relationship with Hemiptera. The sucking mouth of the Anoplura appears to be built on a very different plan from that of the Hemiptera, and the Siphunculata most certainly are very different. I consider that the Hemiptera are the most isolated of all the large orders and their origin is obscure.

That such highly specialized mouth organs, with their special line of development going back into the embryo, could have originated independently in two or more different groups, is highly improbable, so we must, therefore, consider the Hemiptera to form a monophyletic order, very ancient and very isolated. That they are ancient is demonstrated by the fact that in the Trias of Australia the divisions of Cicadidae, Cercopidae,

Cicadellidae, and Fulgoroidea were well established; and one of the oldest fossil insects, *Prosbole* of the Permian, can be placed in the existing family Tropiduchidae.

During the course of insect evolution a number of attempts have been made to produce a piercing and sucking mouth. For perfection of mechanism none surpasses, nor even equals, that of the Hemiptera. This may account for the constancy of type through such a long period of time and in such a large group.

With the exception of the Thysanoptera and Anoplura, where the mouth parts are much more generalized, the Hemiptera is the only order of ametabolus insects with a complete piercing and sucking mouth, and the only order in which such a type of mouth arises in the embryo.

There are a number of types of venation within the order, but I know of no one character, or group of characters, by which all can be separated from all other orders.

The Two Suborders.

The two suborders, the Heteroptera and the Homoptera, are divided mainly on the shape of the head and the position of the labium. In the Heteroptera there is a well-developed gula, which is very long in some groups; the head projects forward and the proboscis is bent at its base and lies under the head when at rest. In most of the Heteroptera there are four segments to the labium, but in some the mentum and submentum are fused, thus making only three segments. In the Homoptera the gula is absent or represented only by a small membrane; the head is deflexed and inflexed so that the base of the labium is in intimate connection with the prosternum; the submentum is membraneous, and in many forms the mentum is reduced. The labium, when at rest, projects backward between the legs, more or less in line with the head, and is not bent at a sharp angle to it.

Of the two suborders the head of the Heteroptera appears to me to represent the more generalized type. Whether the primitive Hemiptera had its mouth organs deflexed beneath its head or standing straight out, it is difficult to judge. The highly developed mouth organs of the Heteroptera of today are not the primitive type of the order. This was evidently a more general-

ized type from which both suborders evolved, the Heteroptera retaining certain of the more primitive characters.

The distinction between the two suborders generally given in text-books, of the "beak" arising from the front or back of the head, is incorrect. The "beak" arises from the same place in both suborders, but in one the gula is large and the head straight out, while in the other the gula is small or absent and the head turned under.

My objection to considering these two suborders as distinct orders is that, by so doing, we divide a monophyletic group and make the same distinction between them as we do between them and Coleoptera and other orders. The characters of the tegmina, upon which the two suborders are generally based, and upon which they are named, do not hold good, for some of the Homoptera are heteropterous and some of the Heteroptera are homopterous. If we use the venation to separate the two suborders, then we must be logical and divide the Homoptera into several orders.[1]

The Two Groups of the Homoptera.

The line of evolution of the head that has divided the Homoptera from the Heteroptera has continued within the Homoptera and divided them into two groups, the Auchenorhynchi and the Sternorhynchi. In the former, the labium, while being intimately related to the prosternum, is still in close relationship with the head capsule. In the latter, a portion of the head capsule, along with the clypeus, labium and tentorial structure, is more or less detached from the head capsule; the labium is in more intimate contact with the prosternum, and an invagination at the base of the labium penetrates the thorax and forms a setal chamber or crumena, wherein the setae lie coiled when at rest. In the Aphiidae and Psyllidae the relationship of these parts can be plainly seen, but in the Coccidae and some Aleurodidae the head is greatly reduced and the true relationship is lost or very obscure.

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[1] Dr. E. Bergroth informs me that the Heteropterous family Peloridiidae has no gular region, and that the labium is not bent at the base. This is a very interesting fact and I would like to examine one of these rare insects.

That the Homopterous head has departed further from the primitive type than the Heteropterous, or is more highly specialized, is the conclusion I have arrived at after a fairly extensive study; and that the Sternorhynchi have specialized along this line further than the Auchenorhynchi is a conclusion that appears to follow as a natural sequence.

The Sternorhynchi.

It is beyond the scope of this paper to enter into a discussion of the four families, or superfamilies, forming this group. That they are highly specialized in habit and structure, and that the latter is often specialization by reduction, soon becomes evident to the student. The one or two jointed tarsi, the reduction of venation, the simplification of the genitalia, and the reduction of head and thorax are all characters in question. To a certain extent these reductions of organs coincide with reduction of size and a sedentary habit. From my present knowledge I am convinced that these simplifications are specialization by reduction and not primitive conditions. It should be realized that ideas on this point are of importance, as they influence the whole conception of the evolution of the order.

The Psyllidae, as we know them today, are too highly specialized to form the ancestor of the other three families. This ancestor must either have been a much more generalized psyllid or a generalized aphid. The Coccidae are the extreme specialization of the group.

The four families, or superfamilies, that compose this group have been treated as suborders, and there is a tendency even to consider them as orders. When we examine the characters that are used to separate them it is found that they are very slender and not of sufficient weight to justify us in so doing.

MacGillivray[1] divides the order into three suborders, viz., Heteroptera, Homoptera, and Gularostria. He restricts the term Homoptera to the Auchenorhynchi, and the Sternorhynchi he terms Gularostria. The former he defines as follows:

"b. Antennae minute and inconspicuous, setiform or awl-shape; tarsi with three segments; prothorax large and conspicuous ..... Homoptera."

[1] MacGillivray, 1921. The Coccidae, p. 4.

The only one of these characters that will stand is the three-jointed tarsi. The antennae are never minute or setiform, and in many species the first and second segments are large, very conspicuous, and in some cases of peculiar shape. The arista or flagellum is thin, in some cases distinctly jointed, in others indistinctly or not jointed. The prothorax is sometimes small and not at all conspicuous.

Orders and suborders founded upon such trivial characters cannot take the same status as orders such as Coleoptera, Diptera, or Hymenoptera. It is, therefore, to be regretted that they are given ordinal or subordinal rank.

Some writers have derived the Psyllidae from a Psocid-like ancestor, and so, naturally, we must consider all the other Homoptera and Heteroptera as derived from the Psyllidae. In my opinion this is a reverse of the true order.

Auchenorhynchi.

This group is divided into two superfamilies, the Cicadoidea and the Fulgoroidea, upon a number of important characters. The small family Tettigometridae is of great interest, as it has a number of characters belonging to both groups.

Three ocelli are found in one family of the Cicadoidea, the Cicadidae, and also in the majority of one family of the Fulgoroidea, the Cixiidae. The latter fact is often lost sight of by systematists and phylogenists when discussing the Homoptera.

In the Cicadoidea the antennae have only a few sense-organs situated on the flagellum; in the Fulgoroidea they are numerous and generally of a complex nature, and mostly situated upon the second segment.

In the Fulgoroidea the middle coxae are articulated considerably apart and have considerable range of movement; this is similar to the condition of the front legs of most insects and of all the legs in such primitive insects as *Machilis*. In the Cicadoidea the middle coxae are much nearer together and their movements very limited, which we must consider as a specialization. In the Cicadoidea the hind coxae are mobile; in the Cicadidae and Cercopidae they are small and do not reach the lateral margins of the thorax, whereas in the Membracidae and Cicadellidae they are wide and reach the lateral margins of the

thorax. In the Fulgoroidea the hind coxae are immobile and their exterior part is coalesced with the metathorax.

In all the Cicadoidea, with the exception of the Cicadellidae, and in all the Sternorhynchi, one finds a wonderful arrangement of the alimentary tract whereby the posterior portion of the mid-gut is brought into intimate contact with part of the crop. This allows certain of the more fluid contents of the crop to pass through the walls of the crop and mid-gut by osmosis, the more solid portion passing through the intestine and undergoing digestion. The fact that the Membracidae possess a filter or colum and the Cicadellidae do not, although they are otherwise so closely related, is difficult to account for. The simplest way would be to consider that they have lost it since parting from the main stem. But we have no evidence at present that they have, so we must give this distinction weight when considering phylogeny. The Fulgoroidea and the Heteroptera possess no sign of a filter.

In the Cicadoidea and in the Delphacidae and in part of the Cixiidae the ovipositor is complete, the anterior and middle pair of processes (the latter amalgamated into one in whole or in part) are fastened together by a tongue and groove so that they work as a single organ. In the remainder of the Fulgoroidea and the Sternorhynchi the ovipositor is greatly reduced or incomplete, the anterior and middle pair are not co-ordinated, and often the three pairs are rudimentary or are entirely absent. The complete ovipositor is the primitive type among the Homoptera. The incomplete ovipositor often has secondary adaptations for cutting into plants for depositing their eggs.

The male genitalia are much more complex and difficult to understand. Our present knowledge stands as follows:

The genitalia of the sexes are homologous in so far that they arise from similar processes situated in the same position on the abdomen. Their relationship is as tabulated below, where g 1 is the anterior, g 2 the median, and g 3 the posterior processes or gonapophyses.

	Female	Male
g 1.	Guides of ovipositor	Genital plates, often amalgamated to pygofer
g 2.	True ovipositor	Aedeagus
g 3.	Ovipositor sheaths	Genital styles

The pygofer of the male is formed of the ninth tergite, together with the coxites (or endopodites) of the eighth sternite, except in the Cicadidae. In the Cercopidae, Membracidae, and Cicadellidae the anterior processes (g 1) are often free, broad plates (the genital plates of systematists). These are sometimes joined together for most of their length and amalgamated to the pygofer, but they are distinctly present in some form. In the genus *Tettigometra* g 1 are well developed and distinct as in the families above mentioned. In all other Fulgoroidea they are generally indistinguishable, having been completely incorporated into the pygofer, or they form comparatively small processes on the pygofer. In the Cicadidae the coxites and eighth sternite form a large plate, the hypandrium, below the pygofer, and the pygofer is membraneous along the median ventral surface. The genital styles (g 3) are well developed and articulate in all the families with the exception of the Cicadidae, where they are rudimentary and fixed on the sides of the pygofer. They are large and complex in some Fulgoroidea. The aedeagus in its simplest form appears to consist of a swollen basal portion, the periandrium, and a more distal portion, the penis, which is generally tubular. But this organ is the most polymorphic of all the genitalia, and in the fulgorids forms good distinctions between some of the families. In some male fulgorids the eighth abdominal sternite is distinct and free from the pygofer, in others it is closely attached to the pygofer and in still other species it is amalgamated to the pygofer and not recognizable as a separate sclerite.

The Families of the Fulgoroidea.

Although I fully recognize the value of Hansen's work, yet I am compelled to differ from his conclusion that the thousand and odd genera of the Fulgoroidea form but a single family. The external characters that separate these genera into groups are much more distinct than many ofttimes used in other orders for the erection of families, and in most cases these characters are supported by good distinctions in the male genitalia.

In discussing the venation of the Fulgoroidea, Metcalf[1] remarks: "While the wing venation of most of the insects that

[1] Ann. Ent. Soc. America, VI, 3 (1913), p. 343.

have been studied extensively so far can be reduced to a more or less uniform type for the family, in the Fulgoridae no such typical form can be given." The same might be said of any group if some fourteen families were thrown into one, and is, in itself, a sufficient reason to indicate that we are dealing with a number of families.

The classification of the Homoptera is founded upon other characters than wing venation, but a type of venation can be recognized as pertaining to most of the families. If we were to make a classification upon venation alone, without any knowledge of the rest of the insect, as we are forced to do with fossil Homoptera, it would be very different from our present one. The Sternorhynchi would have no connection with the Auchenorhynchi; the Psyllidae would be placed next the Psocidae if not with them; some of the Flatidae would be placed among the Cicadoidea because the claval veins do not form a Y; such forms as *Tessitus insignis* Walker would also be placed with them, perhaps to form a distinct family; the Tropiduchidae, as we know it now, would form several families not closely related; the Derbidae would be considered as several families and some placed with the Cixiidae; the Delphacidae would be treated as Cixiidae, and most of the other families would be changed considerably. Pterologists might maintain that such a classification would represent the natural order of things better than the present one made by entomologists. It demonstrates the great care necessary when basing conclusions upon a few fossil wings, for similar deceptions as the Psyllidae and Psocidae may have existed in the past, and we have no means of recognizing their existence.

But as fossils are the only direct evidence of the time sequence of evolution we must take every advantage of them, and for this reason a closer study of the venation in each family must be made. Except in three families of the Fulgoroidea, I have not sufficient knowledge to make a close comparative study of the venation, but there are several points which require discussing before such a task can be undertaken with any satisfaction.

The two chief points are the status of the costa and the anal veins. Unfortunately, Metcalf [1] only traced the tracheae of the

[1] Ann. Ent. Soc. Amer., VI, 3 (1913), pp. 341-352.

fore-wings down to the alar bridge in three cases. In two of them, *Amphiscepa bivittata* and *Thionia simplex,* the costal trachea is shown arising from the bridge; in the third case, *Scolops,* it arises from the subcosta. In all the genera that I have examined so far the trachea agrees with *Scolops* and arises from the subcosta. In these latter cases the question arises as to whether this trachea is homologous with the costa. Tillyard[1] has shown that the Dipteron, *Comptosia* sp., has a distinct costa arising from the alar trunk and a humeral arising from the subcosta. He has also shown good reasons for regarding the humeral and Sc′ as homologous. If Metcalf had not shown that in two cases this trachea arises from the alar trunk, I should not hesitate to consider the costa as absent and the humeral (or Sc′) as present in all the fulgorids. While I shall use the term costa for this vein, I leave its true homology an open question whose solution will influence our conception of the primitive type of venation of the group.

By calling this vein the costa we are faced by the fact that, in a large proportion of the fulgorids, the costa vein and costa margin do not coincide, but the vein lies considerably within the membrane, leaving a precostal cell or *costal area.* This is a condition recognized in no other order of insects. In certain genera, such as *Xiphidium, Conocephalus,* and some *Blattidae,* there is a trachea arising from the subcosta, which appears homologous to the vein under discussion, but Comstock refrains from calling it a costa.

The second point is the supposed movement of A1 to Cu. This has been discussed by Tillyard,[2] and I consider that his contention, that Cu does have more than two branches, is more logical than the contrary. Metcalf[3] remarks that the Cu and first anal "are united for a short distance from the body trachea and cubitus is usually two-branched," but he gives no evidence to show that a branch of A moves over to Cu, but accepts it from Comstock and Needham.

The cubital system of the Homoptera, and also of the Corrodentia, is identical with that found in neuropteroid insects such

[1] Tillyard, 1919, Pro. Linn. Soc., New South Wales, p. 548, fig. 50.

[2] t. c., p. 570.

[3] Metcalf, Ann. Ent. Soc. Amer., VI (3), pp. 341-351 (1913).

as *Sisyra flavicornis, Polystaechotes punctatus, Chauliodes pecticornis, Hemerobius humuli,* and *Sialis infumata,* to name but a few. There is neither evidence of, nor necessity for, the crossing over of A1 to the Cu system. I have stated[1] that in the Delphacidae the suture was formed by the fourth cubital and first anal. This is incorrect, as it is formed solely by the posterior branch of the cubitus, as in all Homoptera, the first and second anal forming the Y veins of the clavus. In some fulgorids, i. e., some Fulgoridae, the third anal is present.

The absence of a distinct, free R1 in the adult tegmen is characteristic of most of the living Auchenorhynchous Homoptera, but it is found in the Mesozoic Cicadid *Mesogereon* Tillyard. The R1 trachea has been found in the early nymphal stages of Cicadidae and Membracidae, and it is probable that it will be found in the early nymphal stages of some of the Cixiidae.

The amalgamation of the bases of M and Cu appears to be characteristic of all recent Cercopidae and so cannot represent a primitive type, even in those forms in which Sc is normal. The venation of the Cicadellidae and Membracidae is too specialized to represent a primitive condition, and so is that of the Sternorhynchi.

I consider that the most normal and primitive type of venation of recent Homoptera is to be found among the Cixiidae. Here we find Sc, R, M, and Cu all arising from the basal cell and M with four normal branches. The genus *Andes* Stål has a venation of this type. The tegmina are steeply tectiform, the ovipositor is complete, and there is a median ocellus. But it has a typical fulgorid head.

In most Fulgoroidea the Y vein is present, but in some it is not; in the Cicadoidea it is never distinctly present. When not present in fulgorids they can be distinguished from Cicadoidea by the two claval veins passing out of the end of the clavus and not entering the hind margin before the apex of clavus, as they do in most Cicadoidea.

The interesting Mesozoic fossil genus *Ipsvicia* Tillyard has a Y vein, but otherwise it might be placed among some of the existing Cercopidae. I consider that it is closely related to the

[1] Muir, Pro. Haw. Ent. Soc., II (1913), p. 269, Pl. 6, figs. 1, 2.

Tettigometridae, and it cannot be considered as more primitive than some existing fulgorids. Handlirsch placed *Prosbole hirsuta* Koken in the Palaeohemiptera. Tillyard considered that it is not on the direct line of descent of the Heteroptera, but on a side line, nearly allied to *Dunstania* Tillyard, which he considered as in the direct line. In *Prosbole* the Sc and R are amalgamated to slightly before the node, a condition common in the Homoptera, but, so far as I know, not found in the Heteroptera. There is no sign of a median furrow, and the anal furrow is behind the cubitus in the normal homopterous position, whereas in the Heteroptera it is normally before the cubitus. As we have only the venation to judge by, I should place *Prosbole* among the Homoptera in the Tropiduchidae. The heteropterous condition found in *Prosbole* occurs in several genera of the Tropiduchidae, especially among the Tambiniini.

Fossil Homoptera are not very numerous, but the few we know, especially the Mesozoic, are of great interest. They demonstrate beyond any doubt the great antiquity of the order. In the Mesozoic Homoptera of Australia we find the two great superfamilies of the Auchenorhynchi completely established. The Cercopidae, Ciccadellidae, and Cicadidae are completely differentiated, and the Fulgoroidea are also represented. This indicates that we must go back far beyond that period for the origin of the order, or believe that evolution proceeded at a very much greater rate before than after the Trias.

The following table is not considered final, as further study in some of the families may change my views; and in the process of time, and with accumulated knowledge, some of them are sure to be divided. Neither is the table completely satisfactory, as the division between one or two of the families may not prove to be complete. Such a case is that between those Cixiidae without a median ocellus and with lateral carinae on the clypeus, and the Dictyopharidae. But the student soon becomes familiar with the facies of these insects and recognizes them at once.

TABLES OF THE FAMILIES OF THE FULGOROIDEA.

1. (2) **Antennal flagellum segmented. No mobile spur on hind tibiae. Lateral ocelli not outside the lateral carinae of frons; lorae plainly visible in full view forming a continuous curve with clypeus** ..... ***Tettigometridae***

2. (1) Antennal flagellum not segmented. Lateral ocelli outside the lateral carinae of frons, generally beneath the eyes; lorae not visible in full view or forming an angle with clypeus.

3. (4) Hind tibiae with a mobile spur at apex. Tegmina without a costal area ..... *Delphacidae*

4. (3) Hind tibiae without a mobile spur.

5. (6) Three ocelli present..... *Cixiidae* in part

6. (5) Two or no ocelli.

7. (8) Posterior angle of mesonotum restricted off by a groove or fine line. Costal area present or absent..... *Tropiduchidae*

8. (7) Posterior angle of mesonotum not restricted off by a groove or fine line.

9. (10) Anal area of wings reticulate. Lateral carinae of frons continued on to clypeus. No costal area, or only a very narrow one without cross-veins. Clavus open, the Cu 2 (Claval suture) and claval veins continuing to apical or hind margin and often branched ..... *Fulgoridae*

10. (9) Anal area of wings not reticulate or, if so, then lateral carnae of frons not continued on to the clypeus.

11. (12) Face transverse or nearly as long as wide, lateral edges angular. Anal area of wings sometimes reticulate, in which case no lateral carinae on clypeus. With or without costal area. Clavus often roundly closed; claval veins reaching apex of clavus, the suture (Cu 2) and claval veins continuing to the apical or hind margin, and sometimes branched..... *Eurybrachidae*

12. (11) Lateral edges of face not angular or, if so, then face distinctly longer than wide.

13. (26) Tegmina without a costal area, or only a small one without transverse veins.

14. (19) Claval vein not entering apex of a closed clavus, but joining the commissure or suture before apex, or the clavus is open.

15. (16) Apical segment of labium short or very short (*Venata* an exception) ..... *Derbidae*

16. (15) Apical segment of labium much longer than wide, sometimes very long.

17. (18) Sides of clypeus acute or with carinae. Apart from the lateral edges, frons generally with two or three carinae. *Dictyopharidae*

18. (17) Apart from the lateral edges, the frons with not more than one (median) carina. Sides of clypeus rounded, without carinae. *Cixiidae* in part

19. (14) Claval vein entering apex of clavus.

20. (21) Base of abdomen with one or more appendages bearing three hemispheroidal depressions ..... *Achilixiidae*

21. (20) Base of abdomen without lateral appendages.

22. (23) Tegmina when at rest nearly horizontal or but slightly tectiform. Hind margin beyond clavus generally expanded, and when at rest overlap..... *Achilidae*

23. (22) Tegmina when at rest steeply tectiform; hind margin beyond clavus not expanded, and do not overlap when at rest.

24. (25) Tegmen large, tectiform. Hind edge of pronotum slightly roundly emarginate; mesonotum large, long. No spines on hind tibiae. *Acanaloniidae*

25. (24) Tegmina generally smaller. Head as wide, or nearly as wide, as the thorax. Posterior edge of pronotum straight, rarely slightly concave; mesonotum short. Hind tibiae with spines. Tegmina often coriaceous or subcoriaceous..... *Issidae*

26. (13) Tegmina with a distinct costal area with transverse veins.

27. (30) Clavus not granulate.

28. (29) Head wider than pronotum, seldom a little narrower, sides of clypeus often without carinae. Pronotum without carinae or with an obscure median carina; mesonotum very large; front legs simple..... *Ricaniidae*

29. (28) Head narrower than pronotum. Sides of clypeus with carinae. Pronotum with carinae. Front legs expanded..... *Lophopidae.*

30. (27) Clavus granulate. Apex of clavus sometimes blunt and closed, sometimes open. Claval veins separate or joined together at apex ..... *Flatidae*

I. Tettigometridae.

Tettigometridae Germar (1821), Magaz, Entom.; type **Tettigometra** Latreille (1804), Hist. Nat. Ins., 12, p. 312.

From the viewpoint of morphology and the relationship of the various fulgorids this family is the most interesting and important, although it is one of the smallest. Its synthetic characters make it hard to say whether it should be placed in the Cicadoidea or the Fulgoroidea, or whether it should be placed in a group by itself. For systematic purposes I have kept it in the Fulgoroidea because the majority of its characters indicate that to be its correct position.

Its cicadoidean characters are as follows: The arista of the antenna is segmented; the shape of the head is typically cicadoidean, the frons reaches from eye to eye without any lateral carinae dividing off a small area around the eyes (a continua-

tion of the genae) on which both the lateral ocelli and the antennae are situated; the lateral ocelli are present on the frons; the antennae are situated nearer together than the eyes and not distinctly beneath them; the lorae are plainly visible in full view and form a curve with the clypeal region; the middle coxae allow of very little movement in a transverse direction and, in some species, the male genitalia have the genital plates (g 1) well developed and free.

The fulgoroidean characters are as follows: The second segment of the antenna is large and bears large and comparatively complex sense-organs; tegulae are present and well developed; the posterior coxae are fixed; the spiracles are on the lateral areas of the abdomen; the empodium is free for the greater portion of its length, and its apex is not deeply emarginate; the tegmina have a Y claval vein.

The tegmina are small, convex, coriaceous and have a resemblance to the tegmen of Cercopidae. The subcosta and radius are joined to beyond the middle, the claval veins form a Y, and there are irregular cross-veins in the apical area.

In *Hilda breviceps* (fig. 2) the genital plates (g 1) are amalgamated to the pygofer, but are recognizable; the periandrium is semibulbous, large, and in contact with the base of the anal segment, which is very short; the penis is short and tubular, the apodeme of the penis is large. In *Tettigometra* sp. (fig. 1) the genital plates are large and free; the periandrium forms a large ring which touches the base of the anal segment; the penis is long, angular in middle, and has a large membraneous "sac" at apex; the anal segment is large.

With the exception of the female external genitalia, which are abortive, and the venation, all the characters of this family are primitive. Whether it represents the direct line of evolution from the precicadoidean type to the fulgoroidean, or whether it only represents an offshoot from the lower stem, it is difficult to say. But its cicadellian characters and the fact that the Cicadellidae have no intestinal filter, support the idea that the primitive cicadellian type was the starting point of the splitting of the group into two, and that the Cicadellidae are the more direct descendants from the primitive type, but do not now

contain all the primitive characters, and are highly specialized in certain directions.

It is interesting to note that the two types of male genitalia found in the Cixiidae are represented in the Tettigometridae by generalized forms, and so may go back beyond the Cixiidae.

II. Cixiidae.

Cixoides Spinola (1839), Soc. Ent. Fra., VIII, p. 202; type **Cixius** Latreille (1804), Hist. Nat. Crus. Ins., XII, p. 310.

This family contains from ninety to one hundred genera. Except in a limited manner in faunistic works, it has not been revised since 1866, when Stål tabulated thirteen genera. From a point of view of morphology and phylogeny it is of great interest, as from it, according to my views, the other families of the Fulgoroidea, with the exception of Tettigometridae, have most likely evolved.

The chief characteristic of most of the Cixiidae, but not all, is the presence of a third ocellus. Apart from this, the absence of certain characters separates them from other families. The tegmina have no costal area, or only a small one at the base, and then it has no transverse veins. The claval vein runs into the hind margin of the clavus or, in a few cases, into the suture near the apex; the clavus is closed. There is no mobile spur on the hind tibia. The apical segment of labium is distinctly longer than wide, generally of considerable length. When no median ocellus is present the clypeus is often destitute of lateral carinae. The frons never has more than three carinae, viz., the median and lateral.

At present I divide the family into two subfamilies, one of which can be divided into two tribes.

1. (4) Clavus not granulate.....*Cixiinae*
2. (3) No subantennal process and antennae not sunk into pits...*Cixiini*
3. (2) Subantennal process present or antennae sunk into pits. *Bothriocerini*
4. (1) Clavus granulate .....*Meenoplinae*

In many of the genera of the Cixiini the ovipositor is complete; in these cases the abdomen is generally considerably flattened laterally, the tegmina steeply or fairly tectiform, the pygofer longer than wide, with a depression down the middle

in which the ovipositor rests, and the hind tibia seldom has spines. In the other genera the ovipositor is incomplete and often considerably reduced, the abdomen is not flattened laterally but often flattened horizontally; the pygofer is flat, broader than long and covered with wax glands; the tegmina very slightly tectiform, and the hind tibiae often have spines.

In the normal type of aedeagus of the Cixiinae the periandrium is tubular, membraneous or chitinous, and often bears spines or other processes; the penis is often complex and large (figs. 7 and 8), or it is greatly reduced and difficult to separate as a distinct part of the aedeagus (fig. 25). There is a tubular apodeme from the base of the penis, passing through the periandrium and connected with the apodemes of the genital styles. The ejaculatory duct passes through this apodeme and opens on the penis. In the genus *Mnemosyne* Stål the periandrium and apodeme of penis are amalgamated into one and form a strong, chitinous mass, with, in some species, a small membrane at apex to represent the penis (fig. 3). The genus *Kinnara* (fig. 4) is the exception to this type.

In the Meenoplinae (fig. 6) and in the genus *Kinnara* (fig. 4) the periandrium is large, more or less funnel-shape, and the penis is drawn into it, the base of the penis often projecting through and beyond the base of the periandrium. The penis is sometimes also funnel-shape.

The Delphacidae, Derbidae, Tropiduchidae, and Achilixiidae have the aedeagus as in the Cixiinae, or modifications of it, while the other nine families have the aedeagus on the Meenoplinae type.

The fact that the Tettigometridae contain representatives of the two types of genitalia in generalized conditions indicates that the two subfamilies may have arisen among the precixiids, and should be regarded as distinct families.

Unfortunately for systematists we cannot use the absence or presence of spines on the hind tibiae, or the complete or incomplete ovipositor, to divide the Cixiini, as there are too many intermediate stages.

The family will be greatly enlarged by a slight amount of collecting in the tropics.

III. Delphacidae.

Delphacoides Spinola, Ann. Soc. Ent. Fr., VIII, p. 329 (1839); type **Delphax** Fabricius (1798), Ent. Syst. Suppl., p. 500.

This family has been neglected by most collectors, especially in the tropics, but at present it contains over ninety genera. It is recognizable from all other fulgorids by the presence of a movable spur on the apex of the hind tibia. It has been divided into two subfamilies and three tribes.

1. (2) Posterior tibial spur subulate, with cross-section either circular or angular, apex acuminate, without teeth on sides.....*Asiracinae*
2. (1) Posterior tibial spur cultrate, subcultrate or thin, with or without teeth on the hind margin.....*Delphacinae*
3. (4) The tibial spur cultrate, solid, both surfaces convex, distinct teeth along the hind margin.....*Alohini*
4. (3) Tibial spur thin, or if solid, then with the inner surface concave.
5. (6) Spur cultrate, solid but with inner surface concave, no teeth on hind margin .....*Tropidocephalini*
6. (5) Spur thin or foliaceous, sometimes tectiform, with or without teeth along the hind margin.....*Delphacini*

The female is furnished with a well-developed, complete ovipositor, and the eggs are laid in the tissues of the food plant. The base of the ovipositor is situated considerably anterior of the middle of the abdomen, and the pygofer is long and narrow, with a groove along the middle for the reception of the ovipositor. This makes the more posterior abdominal sternites more or less V-shape. The male has a well-developed pygofer, one pair of genital styles and an aedeagus consisting of a single tube which in some forms (Delphacinae) is simple (fig. 9) and in others (Asiracinae) complex, with a distinct penis and large periandrium (fig. 10). In most species there is no evidence of the anterior gonapophyses (g 1), but in others these are quite evident. The venation is of a simple form, very uniform, and similar to that of many Cixiidae. In many species brachypterous forms are known.

IV. Tropiduchidae.

Tropiduchidae Stal (1866), Hem. Afr., IV, p. 130; type **Tropiduchus** Stal (1854), Afr. Vet. Ak. Forh., p. 248.

This family was monographed by Melichar in 1914, at which date he recognized sixty-nine genera. Since then several new ones have been added.

With few exceptions the claval vein reaches to the apex of the clavus, which is acutely closed. In a few cases it joins the suture near its apex, and in a few it joins the claval margin near the apex. In many genera there is a distinct costal area with cross-veins; in others the costal area is entirely missing. The genus *Alcestis* is of interest on account of its peculiar venation. What Melichar considers the subcosta I consider to be the costa, so that in some species there is a very small costal area; Sc and R are joined for some distance at their bases, and Sc gives out branched veins which reach the costal margin.

Melichar uses the presence of a suture that divides the posterior angle of the mesothorax from the disc as the distinguishing character of the family. If the forms it brings together can be retained in one family, then it is of great service and relieves systematists of considerable trouble.

We know little about the genitalia at present. The ovipositor appears always to be of the incomplete form. The aedeagus shows considerable variation in the different groups. In *Ommatissus loufouensis* Muir (fig. 11) the periandrium forms a small ring with two long, slender processes; the penis is long, slender, tubular and slightly sinuate; the genital styles are separate. In *Tabinia formosa* (fig. 27) the genital styles are connected together at their base, the periandrium is like a semitube on the dorsal aspect of the penis (an epiandrium), and the penis is tubular. In *Vanua poyeri* Muir (fig. 20) the genital styles are amalgamated together and form a single, asymmetrical organ; the periandrium is a long, slender, chitinous tube, and the penis is complex and large. There is a large apodeme connecting the base of the periandrium with the apodemes of the genital style. It is possible that what I term the periandrium in this genus is, in reality, the penis, and that the periandrium is absent. It recalls the type found in Derbidae, but it is curved in an opposite direction and there is an apodeme. It is necessary to do

considerable more work in this family before we can follow the connection of the groups of genera. It is highly probable that it will be divided into two or more families.

The following is a slight modification of Melichar's table. I treat the groups as representing two subfamilies and seven tribes.

1. (4) Costal area present with cross-veins.....*Tropiduchinae*
2. (3) Antennae very short, globose.....*Tropiduchini*
3. (2) Antennae longer, double as long as the width of the eye. *Catulliini*
4. (1) Costal area absent or very small and without cross-veins. *Tambiniinae*
5. (6) Costal area absent or very short; subcosta with many branches, some furcate, reaching costal margin.....*Alcestisini*
6. (5) Subcosta without furcate branches reaching to costal margin.
7. (12) Tegmina not leathery.
8. (9) Cross-veins absent .....*Tripetimorphini*
9. (8) Cross-veins present.
10. (11) Cross-veins distad of the middle of tegmin.....*Tambiniini*
11. (10) Cross-veins basad of middle of tegmen, apical area longer than corium .....*Paricanini*
12. (7) Tegmina leathery, reaching but little beyond apex of abdomen. *Hiraciini*

I consider that the Upper Permian fossil *Prosbole* can be placed within this family. It is very similar in venation to the living insect *Neommatissus* Muir, and to *Trobolophya* Mel. I cannot consider it in any way ancestral to the Heteroptera. It has no median furrow, and the posterior furrow (suture) is behind the cubitus and not between it and the media.

V. Derbidae.

Derboides Spinola, Ann. Soc. Ent. Fra., VIII (1839), p. 205; type **Derbe** Fabricius (1803), Syst. Rhyng., p. 80.

This family contains about ninety genera. Every collection of any extent received from the tropics contains new species and genera, and when the tropics of Africa and America are explored for these insects the number of species will soon be doubled.

The eggs are unknown, but they must be laid in rotten wood, or under bark, for that is where the nymphs are found. In some genera the ovipositor is absent or represented by mere

rudiments; in others the gonapophyses are fairly well developed, but never coadapted or developed for cutting, so that the eggs are most likely all laid on the surface.

The family is recognized by the very short joint of the labium, except in a very few cases, together with the absence of other characters. The male genitalia are also quite distinctive. There is great diversity of form within the family; the head in several genera is more bizarre than in any other family of fulgorids, and the tegmina and wings run from quite normal cixiid-like forms to long, narrow tegmina and wings reduced to mere stumps and used as stridulating organs. There is no costal area except in a few forms, and then it is at the base and has no cross-veins. Many species have the claval area granulate.

I divide the family into two subfamilies and six tribes.

1. (4) Tegmina long and narrow. Wings very small or not more than half the length of the tegmina, narrow, the costal and posterior margins subparallel or converging to a pointed apex, the cubital and claval areas greatly reduced, with the claval veins missing or reduced, the posterior basal area large, corrugated and used as a stridulating organ.....*Zoraidinae*
2. (3) Eyes in front not reaching to base of clypeus, subcostal cell long, sometimes very narrow.....*Zoraidini*
3. (2) Eyes in front, reaching to the base of the clypeus; subcostal cell very short or absent; female genital styles abortive..*Sikaianini*
4. (1) Tegmina not long and narrow; wings nearly always more than half the length of tegmina, the anal area large and the cubital and anal veins normally developed.....*Derbinae*
5. (10) Claval cell closed or only narrowly open for a short distance, the extended claval vein not joining cubitus and not forming part of a contiguous series of submarginal cross-veins; cubitus generally proceeding straight to hind margin.
6. (7) Cubitus apparently with four or more veins, reaching to the hind margin .....*Derbini*
7. (6) Cubitus with less than four veins reaching to the hind margin.
8. (9) Cubitus simple or furcate, reaching the hind margin direct, not running into the basal median sector.....*Cenchreini*
9. (8) Cubitus connected with the basal median sector, forming an angular or quadrate cell; sometimes with a cross-vein near the base of the basal median sector, forming a triangular cell; tegmina broad .....*Rhotanini*
10. (5) Clavus open, the cubital veins bent and touching and, together with the extended claval, forming part of the submarginal row of apical cross-veins.....*Otiocerini*

The Cenchreini are the most generalized tribe, and such genera as *Vekunta* approach the Cixiidae very closely. In the genus *Symidia* we have an approach toward the Zoraidinae and in the genus *Phaciocephalus* toward the *Otiocerini*.

So far no fossil forms have been recognized. The present distribution is over the entire tropics in forest country, with a few straying into temperate regions. The Zoraidinae and the Rhotanini are only known from the Eastern Hemisphere, while the two genera *Derbe* and *Mysidia* are confined to the Western Hemisphere.

The aedeagus is quite typical of the family and can be recognized from all other fulgorids. The pygofer and anal segment are normal; the latter is often large and produced into one or two spines at the apex; the former is generally produced into the middle of the ventral margin. The genital styles vary in size and shape, their apodemes are fairly large and free from all connection (except muscular) with the aedeagus, and thus differ from most other fulgorids. The aedeagus is long, subtubular, slender, and curved upward, with a complex structure at the apex; the base is in contact with the base of the anal segment and has a large surface connection with the body membrane. The curved basal section I am inclined to regard as the periandrium (fig. 28, pa.) and the apical section as the penis. Under this interpretation there is no apodeme of the penis, but only a small, strong apodeme on the base of the periandrium for the attachment of muscles. This type of genitalia, with slight modification among the Zoraidini, is found all through the family. The genus *Venata* Distant has this type of genitalia and must be included in the family.

VI. Achilixiidae.

Type **Achilixius** Muir. Philippine Jour. Sci., 22 (5) (1923), p. 483.

This family is easily recognized by the two processes on each side of the base of the abdomen, the anterior larger than the posterior. The larger bears two hemispheroidal depressions and the smaller bears one. There is a somewhat similar appendage at the base of the abdomen in the genera *Benna* and *Bennaria* of the Cixiidae. The posterior margins of the tegmina beyond the clavus are not produced and do not overlap when at rest, the tegmina

being considerably tectiform. The male genitalia are very different from those of other families, but the nature of the aedeagus places it in the Cixiine group, although otherwise it might be placed near the Achilidae in the Meenopline group.

The male pygofer is normal, with a transverse bar across the middle to which the base of the aedeagus is attached (fig. 5, t. b.); the aedeagus shows no sign of division into periandrium and penis, but is cultrate, the ventral margin being double and curved, the dorsal margin straight and single. The ovipositor is incomplete.

The family is erected for a single genus containing four species. I hesitated before erecting the family, but as the genus cannot be placed in any recognized family without doing violence to the family characters it is best placed by itself.[1]

VII. Dictyopharidae.

Dictiophoroides Spinola (1839), Ann. Soc. Ent. Fra., VIII, pp. 202, 283; type **Dictyophara** Germar, Silb. Revue Ent., I, p. 175 (1833).

This family was monographed by Melichar in 1912, at which time he recognized seventy-six genera. He divided it into five groups, which I shall consider as two subfamilies with five tribes.

1. (6) A distinct suture dividing clavus from corium; tegulae and ocelli present ..... *Dictyopharinae*
2. (3) No cross-veins in the clavus..... *Dictyopharini*
3. (2) Clavus with a cross-vein between first claval and suture.
4. (5) Tegmina with narrow costal area..... *Dichopterini*
5. (4) Tegmina without costal area..... *Cladyphini*
6. (1) No suture dividing the clavus from corium..... *Orgerinae*
7. (8) Tegmina entirely or almost covering the abdomen..... *Lynciini*
8. (7) Tegmina very short, not nearly covering the abdomen... *Orgeriini*

Melichar called his Group IV Bursini, although he placed the genus *Bursinia* Costa in his Group V, Orgerini. The above classification is likely to be modified with further study.

The tegmen has no costal area, or a very narrow one without transverse veins; the claval vein does not reach the apex of clavus. Besides the lateral margins the frons generally has two

[1] The writer has received from Dr. F. X. Williams specimens from Ecuador, representing two species of an undescribed genus which goes into this family. There is only one rounded process bearing three depressions.

or three median longitudinal carina. The family is closely connected with the Fulgoridae. At present it contains a number of aberrant forms which make it difficult to define. It is also difficult to separate from those Cixiidae without a median ocellus.

The periandrium is large, often funnel-shape, membraneous or semi-membraneous, and often has the apical margin divided into lobes (fig. 29). The penis is a short tube or ring with two long processes (fig. 18, 29 a) very similar to the type found in the Fulgoridae (fig. 16).

VIII. Fulgoridae.

Fulgorellae Latreille (1807), Ger. Crust. Ins., VII, p. 163; type **Fulgora** Linn., Syst. Nat. (1767), I, p. 703.

Kirkaldy [1] considered that the type of the genus *Fulgora* is *europaea* Linn. and, therefore, should be used in place of *Dictyophara* Germ. For *Fulgora* auctt. (type *Laternaria* Linn.) he used *Laternaria* Linn., which agrees with Stål. The question appears to stand upon whether Sulzer's fixation of the type in 1776 be valid. Van Duzee does not follow Kirkaldy, and as I am not in a position to follow the history of this name I shall place myself with the majority and not make the alteration.

The family stands with about one hundred or more generic names. It needs a modern revision, as nothing has been done to it since Stål's time except in local faunistic works where a number of genera have been described. It contains the largest and most showy species of the superfamily, and so has attracted more attention from collectors than any of the others. In some species the head is greatly elongated and enlarged, and has been stated by some to be luminous. The controversy on this subject is old, but an explanation may be found in Kershaw's discovery that the prolongation of the head is filled by a diverticulum from the crop. The head at times may be filled with bacteria from the stomach and be in the same condition as the silkworm larva when attacked by luminous bacteria.

The reticulation of the anal area of the hind-wings appears to be a constant character of this family, and cross-veins are numerous on the tegmina, which are comparatively narrow. The costal area is absent or forms but a narrow area without trans-

[1] Haw. Sug. Planters' Exp. Sta. Ent. Bull., XII, p. 11, 1913.

verse veins. The Sc is free to the basal cell in some genera, the bases of R and M are generally joined together for a short distance. The clavus is open, the suture (Cu2) continues as an independent vein and is often branched and enters the apical margin. The first and second claval veins form a Y and often continues as a free, branched vein to the apical margin; the third claval (An3) is sometimes present as a free vein in the apical portion of the clavus.

The lateral margins of the frons are generally straight, or if they are angular then the frons is longer than wide.

The female ovipositor is incomplete and is often abortive. The eggs are laid on the surface, in some cases in double rows, and covered with wax. The aedeagus is very similar to that found in the Dictyopharidae. The periandrium is large, funnel-shape, and membraneous, the penis short and produced into two slender processes (fig. 16). The penis is sometimes greatly reduced.

IX. Eurybrachidae.

Eurybrachydida Stal (1866), Hem. Afr., IV, p. 129; type **Eurybrachys** Guer. (1834) Voy. Belang. Ind. Orient, p. 475.

This small family of some two dozen genera is a fairly difficult one to place. In certain characters it approaches the Fulgoridae, in others the Achilidae.

The female has an incomplete ovipositor. The male genitalia are complex and at present not fully understood. In *Gelastopsis insignis* Kirk. (fig. 24) the male pygofer is simple and the genital styles large but normal. The aedeagus is unique, so far as my knowledge extends; it forms a short tube flattened horizontally, on each side arises a large, strong spine-like process, dorsally and ventrally there is a semi-membraneous flap. In *Olonia picea* Kirk. (fig. 12) there is a large plate attached to the ventral margin of the pygofer produced posteriorly into two curved spines; this may represent a development of g 1. The genital styles are large and complex; the aedeagus is peculiar and consists of a membraneous area in which the genital opening is situated, with three pairs of sclerites, the basal pair being the largest, triangular and projecting as two large, broad spines; internally there is a membraneous tube to which the apodeme is

attached (fig. 12 b). The genitalia require much further study before we can place the family with any certainty.

The frons is broad, generally broader than long, and the lateral margins angular. In some genera there is a costal area with cross-veins, in others it is absent. The claval vein runs to the apex of the clavus, which is generally roundly closed; the vein proceeds beyond the clavus and ends in the hind margin and is sometimes branched. The third claval vein (An3) is sometimes present as a free vein in the apical half of the clavus; Cu2 or claval suture continues beyond the clavus, branches and terminates in the apical margin. The anal area of the hind-wing is reticulate in a few species.

X. Achilidae.

Achilida Stal (1866), Hem. Afr., IV, p. 130; type **Achilus** Kirby (1818), Trans. Linn. Soc., Lond., XII, 475.

This is a very homogeneous family of about sixty genera. The chief characteristics of the family are the claval vein reaching the apex of clavus, which is closed; the hind margin produced beyond the apex of clavus; the tegmina, when at rest, very slightly tectiform or nearly horizontal, and the areas beyond the clavus overlapping. In only a few genera is there any sign of a costal area, and then there are no cross-veins.

The female has an incomplete ovipositor. In the male the pygofer is considerably flattened horizontally, there is generally a pair of processes on the medio-ventral margin; the genital styles are large and complex; the aedeagus in *Eurynomeus granulatus* (fig. 23) consists of a periandrium which is produced into three pair of processes, and a penis which is a small tube with two long, flat processes (fig. 23 a). In a large Philippine Achilid at present undetermined (fig. 26) the periandrium and penis are fairly normal, but the apodeme forms a long, semi-chitinous tube, the nature of which I do not understand. A great deal more work must be done upon the family before its correct position in the superfamily can be demonstrated. Certain points place it near the Eurybrachidae and Fulgoridae, but there are others which separate it very decidedly.

XI. Acanaloniidae.

Acanonides Amyot and Serville (1843), Hemip., pp. LVIII, 520; type **Acanalonia** Spinola, Ann. Soc. Ent. Fra., VIII (1839), p. 447.

This small family, which contains only five or six genera, was monographed by Melichar in 1902. It comes very close to some of the Issidae by which it appears to be separated by the absence of spines on the hind tibiae.

The head is about as wide as the thorax and the clypeus lacks lateral carinae. The posterior margin of the pronotum is straight or but slightly concave, the pronotal carinae absent or obscure; the mesonotum is large. The tegmina are steeply tectiform. This family differs from the Flatidae by having no costal area, or if there be one then it is obscure and has no transverse veins.

The ovipositor is incomplete. The aedeagus is complex, the penis and periandrium appear to be amalgamated into a complex tube with appendages (figs. 30, 31), a condition found in some Issidae.

XII. Issidae.

Issites Spinola (1839), Ann. Soc. Ent. Fr., VIII, p. 204; type **Issus** Fabricius (1803), Syst. Rhyng., p. 99.

This is a difficult family to characterize. With the exception of a few cases the head is as wide as the thorax, or wider. The hind margin of the pronotum is straight or but slightly concave or convex; the mesonotum is short, not more than twice the length of the pronotum, with a transverse carina across it parallel to the hind margin of the pronotum, which divides it into two parts; the anterior portion is covered by the pronotum and is generally of a different sculpturing to the posterior portion. This character is also found in some Dictyopharidae and Lophopidae.

The tegmen is without a costal area, or if one be present then it is small, obscure, and without cross-veins. The tegmen is often very short or very narrow and the venation obscured. The legs are generally thick and the hind basitarsus short and thick.

The ovipositor is incomplete. The male genitalia are considerably diverse, even in the few species that I have examined.

In *Hemisphaerius moluccanus* Kirk. (fig. 33) the periandrium is large and semi-membraneous; the penis forms a fairly large tube produced into two processes with a median process in the middle. This aedeagus is like the type found in the Ricaniidae. In *Danepteryx* sp. (fig. 21) the periandrium forms a small tube which fits tightly around the large, semi-cylindrical, curved penis. In *Gelastissus histrionicus* Kirk. (fig. 35) the periandrium is a short, wide tube with the dorsal edge curved over at its apex; the penis is smaller and has two large, curved spines at the apex. In *Aphelonema vespertina* Kirk. (fig. 34) the periandrium is large and membraneous, while the penis is thin and curved. These few examples show the diversity to be found in the family, and indicate the necessity for a great amount of work before we shall be able to understand the relationship of the genera included within it.

Melichar monographed the family in 1906, when he recognized ninety-five genera; since then several new ones have been added. The following division of the family is based on Melichar's work.

1. (2) Tegmina short and only reaching slightly beyond the base of the abdomen, or exceedingly narrow, parchment-like, thick or opaque, seldom hyaline; wings absent or rudimentary.....*Caliscelinae*
2. (1) Tegmina entirely covering the abdomen or the greater portion of it.
3. (4) Clavus and corium not separated by a suture. Tegmina generally convex, thick, and the venation obscure.....*Hemisphaerinae*
4. (3) Clavus separated from corium by a suture.....*Issinae*
5. (6) Wings absent or rudimentary, not folded.....*Hysteropterini*
6. (5) Wings present, entire.
7. (8) Wings with margins entire.....*Issini*
8. (7) Wings with a deep cleft in the apical margin, the anal area very large .....*Thioniini*

The genus *Augila* Stål would come into the Issini. It might be as well to make a separate tribe, or even subfamily of it. *Danepteryx* Uhler and *Gamergomorphus* Melichar would go into the Caliscelinae near to *Alleloplasis* Waterh. It might be more natural to consider the Caliscelinae as a tribe of the Issinae.

XIII. Lophopidae.

Lophopida Stal (1866), Hem. Afr., IV, p. 130; type **Lophops** Spinola (1839), Ann. Soc. Ent. Fra., VIII, p. 387.

This small and homogeneous family was monographed by Melichar in 1915, and twenty-seven genera were then recognized. The head is narrower than the thorax and there is a tendency for the middle portion of the frons to be produced; the front legs are flattened and expanded in most cases; the hind margin of pronotum is truncate; the clypeus is keeled laterally; the hind basitarsus is short and generally swollen; there is a distinct costal area with cross-veins.

I do not follow Melichar's tribes, as the characters he uses do not hold true, and he has placed some of his genera into the wrong tribes, according to his own characters.

The ovipositor is incomplete. The aedeagus has a large periandrium (figs. 15, 17, 19), often considerably complex; the penis forms a short tube with a pair of processes, often of a complex nature. It is a specialization upon the *Dictyophara* type near to the Ricaniidae.

XIV. Ricaniidae.

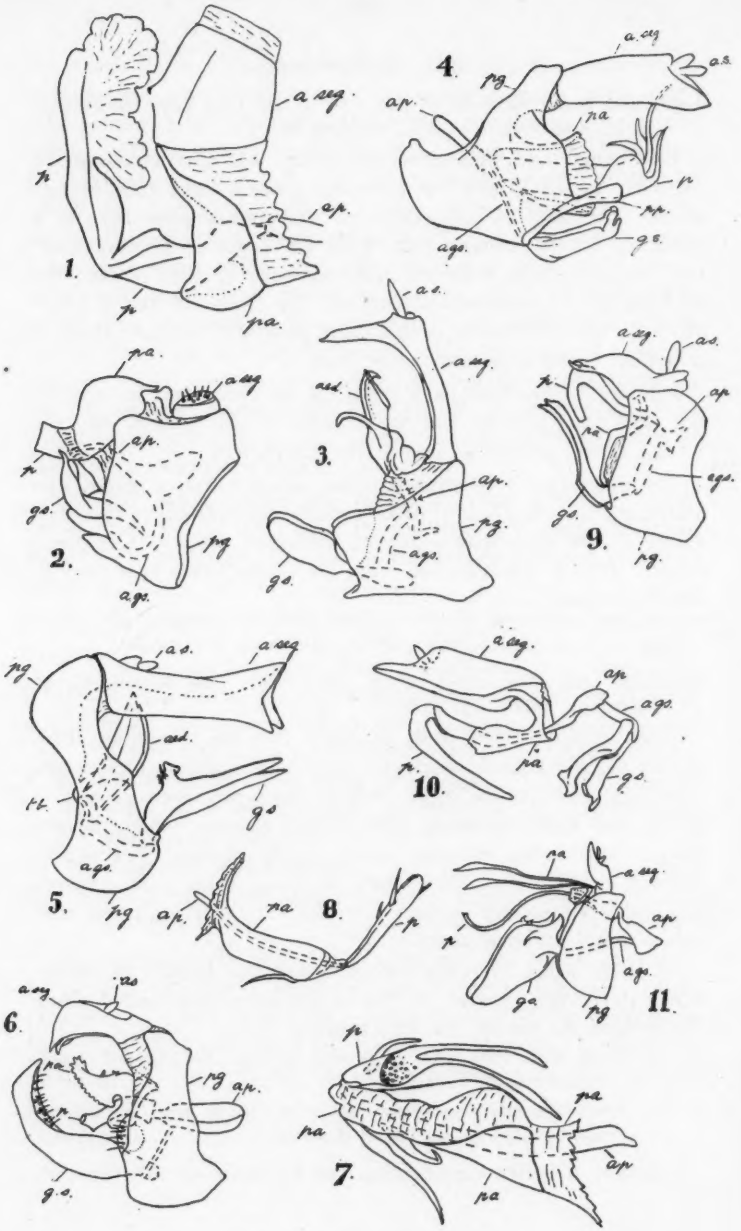
Ricaniida Stal, Hem. Afr., IV, p. 219 (1866); type **Ricania** Germ. Mag. Ent., III, p. 221 (1818).

Head wide, in a few cases narrower than the pronotum. Pronotum slightly roundly emarginate on hind margin; mesonotum very large. Tegmina large, steeply tectiform when at rest, a costal area with transverse veins always present, which is quite distinct even when narrow; clavus not granulate, apex closed, pointed, claval vein reaching apex, the costal veins joining before the middle or shortly beyond the middle. Posterior tibiae with spines; hind basitarsi short.

In 1898, when Melichar monographed the family, he recognized thirty-one genera. A few more have been added since. He divided the family into two groups.

1. (2) Frons wider than long, or as wide as long; the sides of clypeus without carinae ..... *Ricaniini*
2. (1) Frons distinctly longer than wide or as wide as long; in the latter case the clypeus has lateral carinae..... *Nogodini*

I believe a better classification can be made on the venation,



Male Genitalia of Fulgoroidea.

but my present knowledge of the family is too limited to allow me to carry out such a scheme.

In the few genera which I have examined the male genitalia are all built on the same type. The periandrium (figs. 13, 22) forms a large and comparatively simple tube; the penis forms a more or less short tube or ring from which arises a pair of processes more or less narrow and with ample apices; within the penis there is a small process which is sometimes trilobed, and on which the gonopore appears to be situated, and which may represent the true penis.

Most species of this family are comparatively large and often gaily colored, and so they have been given more attention by collectors than the more obscure fulgorids. The family is a very homogeneous one.

XV. Flatidae.

Flatoides Spinola, Ann. Soc. Ent. Fr., VIII, pp. 204, 387 (1839); type **Flata** Fabricius, Ent. Syst. Suppl., 511, 517 (1798).

Head generally narrower than thorax. Pronotum with the posterior margin generally roundly emarginate, in some case subangularly and in a few cases straight; mesonotum fairly

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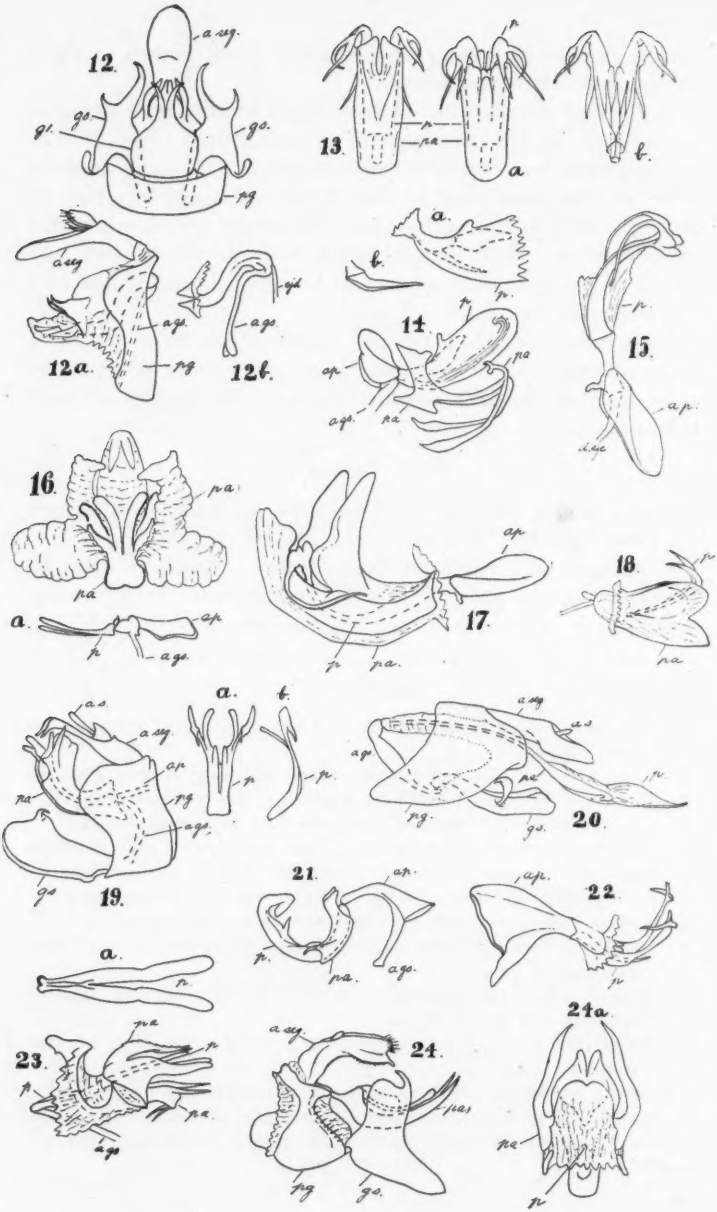
PLATE IV.

1. *Tettigometra* sp. (Tettigometridae). Right side view of aedeagus and anal segment.
2. *Hilda breviceps* (Tettigometridae). Right side view of male genitalia.
3. *Mnemosyne efferatus* (Cixiidae). Right side view of male genitalia.
4. *Kinnara maculata* (Cixiidae). Left side view of male genitalia.
5. *Achilixius singularis* (Achilixiidae). Left side view of male genitalia.
6. *Phaconura froggatti* (Cixiidae). Right side view of male genitalia.
7. *Borysthenes fasciolatus* (Cixiidae). Right side view of aedeagus.
8. *Myndus caligineus* (Cixiidae). Left side view of aedeagus.
9. *Stenocranus seminigrifrons* (Delphacidae). Right side view of male genitalia.
10. *Ugyops kellersi* (Delphacidae). Right side view of anal segment, aedeagus and genital styles.
11. *Ommatissus loufouensis* (Tropiduchidae). Right side view of male genitalia.

Lettering on figures: *aed*, aedeagus; *ags*, apodeme of genital styles; *ap*, apodeme of penis; *as*, anal style; *a seg*, anal segment; *ejd*, ejaculatory duct; g^1, anterior gonopophyses; *p*, penis; *pa*, periandrium; *pg*, pygofer.



Male Genitalia of Fulgoroidea.

large. Tegmina large, in a few genera narrow, with a distinct costal area with cross-veins; the clavus granulate, often open and the claval veins separate, or the claval veins joined near apex.

The family was monographed in 1902 by Melichar, who included the Acanaloniidae. By excluding these we have a homogeneous group of about eighty to ninety genera which can be divided into two subfamilies of strikingly different facies.

1. (2) Body considerably compressed laterally, the tegmina steeply tectiform, the apical portion of the costal margins and the apical margins meeting together, or approaching very closely when at rest ..... *Flatinae*

2. (1) Body not compressed laterally or only slightly so; tegmina horizontal or only slightly tectiform, the apical portion of costal margins not meeting together beneath the abdomen. . *Flatoidinae*

In the few genera in which I have examined the male genitalia they appear to be very uniform. The periandrium forms a short tube or ring and from each side a long, narrow appendage arises which generally has the apex enlarged or complex. The penis forms a large tube, often funnel-shape and flattened

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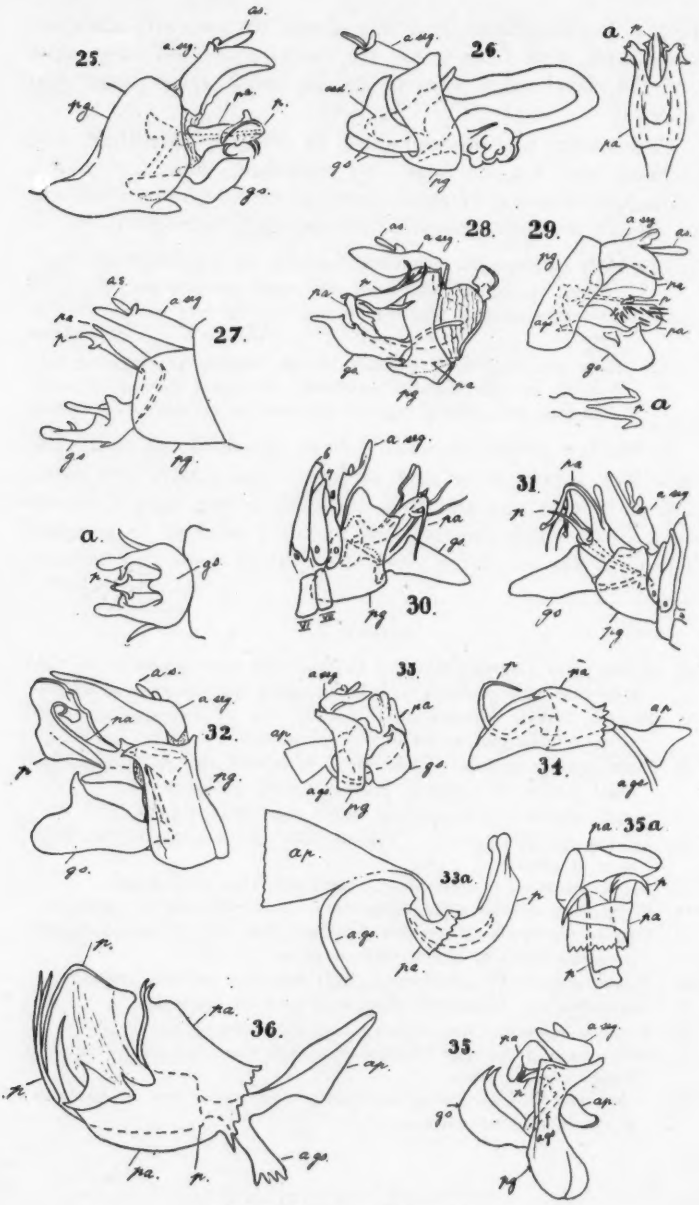
PLATE V.

12. *Olonia picea* (Eurybrachidae). Ventral view male genitalia; *a*, right side view male genitalia with styles and g^1 cut away; *b*, aedeagus.
13. *Pochaza fuscata* (Ricaniidae). Ventral view of aedeagus; *a*, dorsal view of aedeagus; *b*, dorsal view of penis.
14. *Neomelicharia guttulata* (Flatidae). Left side view of aedeagus; *a*, basal portion of penis; *b*, process bearing gonopore.
15. *Pyrella aberrans* (Lophopidae). Right side view of penis.
16. *Aphana* sp. (Fulgoridae). Ventral view of periandrium; *a*, lateral view of penis.
17. *Pyrella aberrans* (Lophopidae). Right side view of aedeagus.
18. *Dictyophara nerides* (Dictyopharidae). Left side view of aedeagus.
19. *Virgilia nigropicta* (Lophopidae). Right side view of male genitalia; *a*, dorsal view; *b*, lateral view of penis.
20. *Vanua poyeri* (Tropiduchidae). Left side view of male genitalia.
21. *Danepteryx* sp. (Issidae). Right side view of aedeagus.
22. *Mindura obscurus* (Ricaniidae). Left side view of penis.
23. *Eurynomeus granulatus* (Achilidae). Left side view of aedeagus; *a*, dorsal view of penis.
24. *Gelastopsis insignis* (Eurybrachidae). Left side view of genitalia; *a*, dorsal view of aedeagus.



Male Genitalia of Fulgoroidea.

laterally, the apical margin being cleft for some distance; on each side of the penis there is often a depression into which the process of the periandrium fits when at rest. Within the penis at its base there is a process on which the gonopore appears to be situated (figs. 14, 32). In the Flatoidinae the periandrium is large, forming a short, thick funnel, and the processes are shorter; the penis is also shorter and wider (fig. 36). The ovipositor is always incomplete.

Phylogeny.

The classification of animals started early in the history of mankind, most likely with the dawn of speech. It was started for convenience and was empirical, and has continued down the ages on the same lines. With the dawn of biological science it was continued scientifically, and a natural order of arrangement became evident. Since Darwin made evolution a living force with biologists the natural arrangement, or natural order, has become predominant, in some cases even to the detriment of utility.

The living species of animals represent the terminal twigs of the tree of insect life of which we examine but the surface.

PLATE VI.

25. *Myndus musivus* (Cixiidae). Left side view of male genitalia.
26. gen. sp. ? (Achilidae). Right side view of male genitalia; *a*, dorsal view of aedeagus.
27. *Tambinia formosa* (Tropiduchidae). Right side view of male genitalia; *a*, ventral view of same.
28. *Phaciocephalus* sp. (Derbidae). Right side view of male genitalia.
29. *Dictyophara europeae* (Dictyopharidae). Left side view of male genitalia; *a*, dorsal view of penis.
30. *Acanalonia* sp. (Acanaloniidae). Left side view of male genitalia.
31. *Amphiscepa bivittata* (Acanaloniidae). Right side view of male genitalia.
32. *Siphanta acuta* (Flatidae). Right side view of male genitalia.
33. *Hemisphaerius moluccanus* (Issidae). Left side view male genitalia; *a*, left side view of penis.
34. *Aphelonema vespertina* (Issidae). Right side view of aedeagus.
35. *Gelastissus histrionicus* (Issidae). Right side view of male genitalia; *a*, ventral view of aedeagus.
36. *Uxantes* sp. (Flatidae). Right side view of aedeagus.

What lies below that surface—the branches, limbs, and trunk—we can only speculate about, using for our guides the arrangements of the terminal twigs and such little evidence as is given us by paleontology. Such speculation we term phylogeny, and its existence entirely depends upon our belief in evolution; the form it takes is moulded by the nature of that belief.

To the phylogenist the cut and dried dichotomous characters, which are such a boon to systematists, are often of little value. On the other hand, those organs showing a graduate series, which are anathema to the systematist, are generally the phylogenist's best friends. It is upon these lines that the following speculations proceed.

The Hemiptera existed before the Heteroptera or Homoptera, and were characterized by the nature and function of the mouth parts. They were more generalized that either of these suborders are today, but they approached nearer to the former. The head would have possessed a gula region, and the beak may have been carried out straight. When not in use this position would be inconvenient, and it was possibly to avoid this that the main dichotomy came about. In the Heteroptera the gula region persisted and even became greatly developed and the beak bent at its base so that it packed away under the head and thorax. In the Homoptera the gula was reduced and the head became inflexed so that the beak when at rest lay straight out beneath the thorax without a bend at its base, thus the base of the labium was brought into intimate relationship with the prosternum. This turning under of the head led to a flattening and widening of the head capsule, especially the more apical portions such as the genae and lorae. This line of evolution of the head was carried to its greatest extent in the Cicadoidea, more especially in the specialized Cicadellidae. The Tettigometridae of the Fulgoroidea retains this type of head, but it is modified slightly along the fulgorid lines. It is possible that in the Fulgoroidea the vertex lengthened and curved downward. In this case the lateral carinae of the frons would represent the ridge above the antennae in the Cicadoidea.

After the departure of the Fulgoroidea from the main stem, or perhaps even before that, there arose the peculiar arrangement of the intestine whereby the "filter" or "colum" was

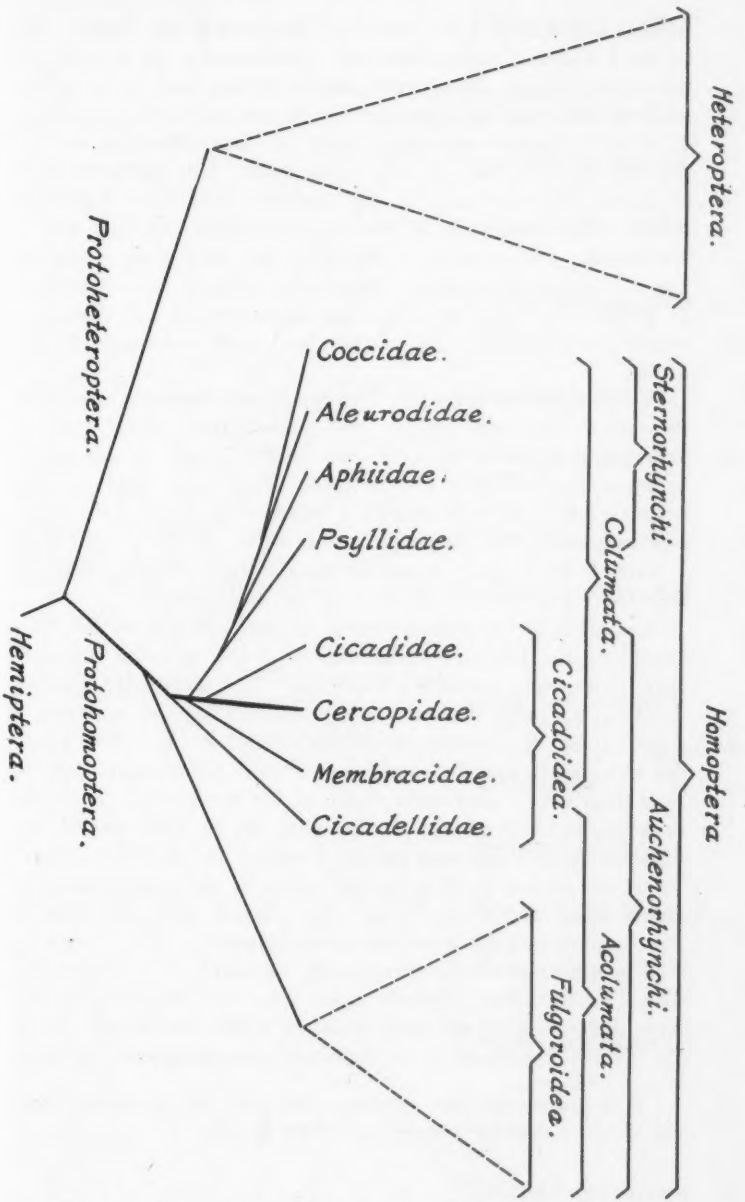


Diagram 1, showing the morphological affinity of the Homoptera.

formed. This must have been on a side branch and it gave rise to the Cicadidae, Cercopidae, and Membracidae, as well as to the Sternorhynchi. The latter followed certain lines of evolution of their own, such as specialization by reduction, the formation of a setal chamber or crumena and the detachment of part of the head capsule from the rest of the head. This reduction may be due to their decrease in size together with their sedentary habits. The formation of the setal chamber may be for a mechanical perfection for controlling the long setae when in use, as well as for a place of protection when at rest. This line of evolution of the Sternorhynchi culminates in the Coccidae, which are in general the smallest and most sedentary of the group.

The venation of the early Hemiptera approached Comstock's theoretical wing very closely, and a somewhat similar type of venation is found in the more generalized of each of the larger groups. The tendency for the bases of the four chief systems to amalgamate one with another is traced through all the groups, especially with the reduction of the width of the wings. This is carried to its greatest extent among the Sternorhynchi and is possibly a result of reduction of size and disuse.

According to my interpretation of the evolution of the Fulgoroidea, the Tettigometridae represent the *modified descendants* of the most primitive fulgorids. They descended from a form having small hind coxae, as in Cercopidae, and not from a form having the present membracid-cicadellid type. The Cixiidae represent a branch from the early stem which have retained certain primitive characters, such as the three ocelli, a simple venation and the complete ovipositor. At an early period the Cixiidae divided into two groups, Cixiinae and the Meenoplini.[1] From the former the Delphacidae arose by the acquisition of a mobile spur on the hind tibia; they carried over and retained the complete ovipositor and the more generalized male genitalia. The modification of the venation in the family is by reduction. The Tropiduchidae evidently came from a Cixiinae stock and have undergone considerable evolution within the family (if all the genera contained in it represent a monophyletic group).

[1] It is possible that this dichotomy goes back to a pre-cixiidae form, and that they should be regarded as distinct families.

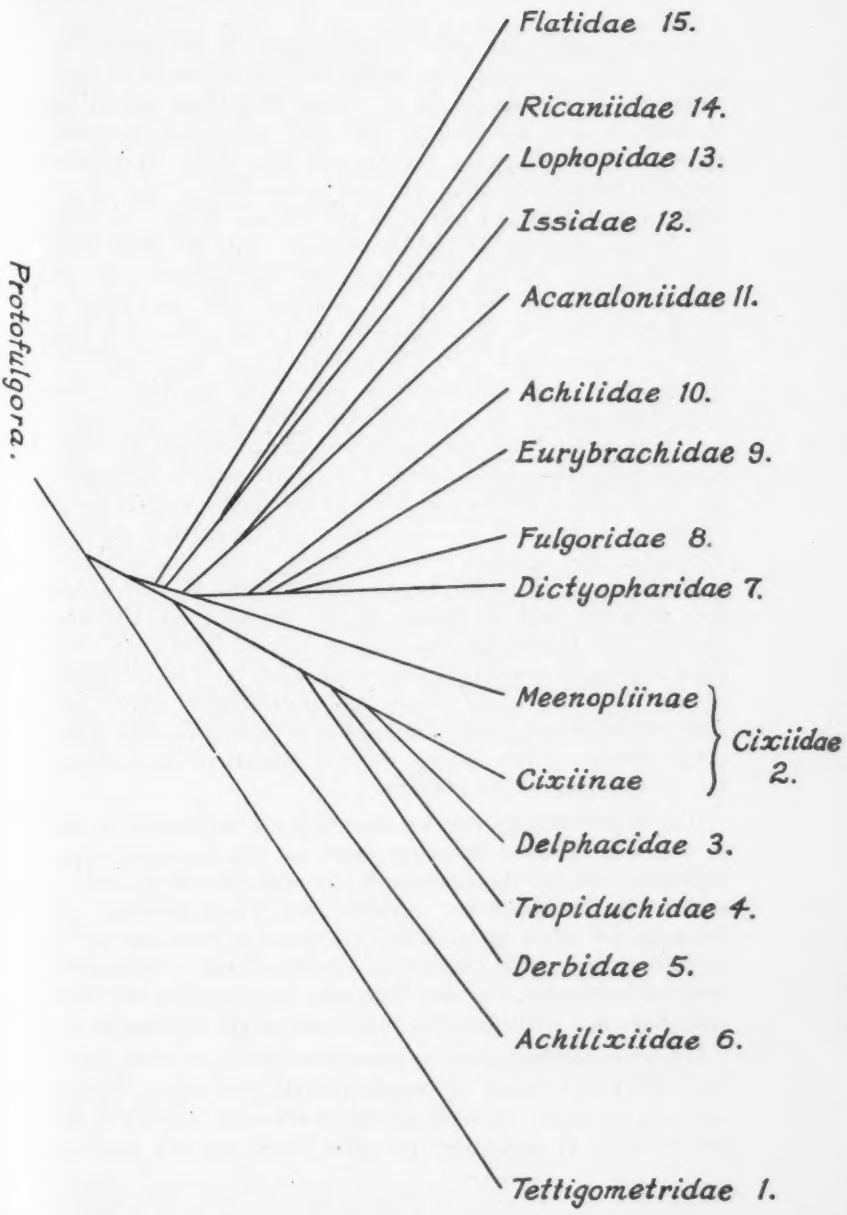


Diagram 2, showing the morphological affinity of the families of the Fulgoroidea.

Platygenesis has taken place in one group and stenogenesis in another. The aedeagus has undergone considerable evolution within the family, but, so far as present knowledge enables us to judge, it is of the Cixiinae type. The generalized Derbidae approach so closely to the Cixiidae that some genera have been shifted from one to another, but they possess distinct male genitalia. The Achilixiidae belong to the Cixiinae group, but they are difficult to place as they have some synthetic characters. The other nine families arose from the Meenoplinae stock or from genera having their type of genitalia. Our knowledge is too slight to allow us to speculate on their relationship with any hope of being correct. The Dictyopharidae and Fulgoridae are closely allied. The Eurybrachidae show some affinities to the Fulgoridae, and so do the Achilidae. The other five families may have arisen from the generalized Dictyopharidae or from a more direct Meenoplinae stem. The Issidae and Acanaloniidae are closely allied, but the possibility of the Issidae being a composite group must not be overlooked. The Lophopidae and the Ricaniidae have affinities, and the Flatidae come close to them. With the exception of the Issidae, one of whose characteristics is a reduction and thickening of the tegmina, the last five families show considerable platygenesis, the last three often having a wide costal area containing cross-veins; the Tropiduchidae in part share this characteristic, and other families show it to some extent. Stenogenesis also appears in several families quite independently, so that neither of these characters can be used for the grouping of the families.

It is to paleontology that we must look for information to fill in our time elements so as to round out our speculations in phylogeny. So far the evidence fits in with the above conclusions. The Tropiduchidae, Cixiidae, and Tettigometridae (if the latter are allied to *Ipsvichia*) are found in Mesozoic times or earlier, along with Cercopidae, Cicadidae, and Cicadellidae; whereas Fulgoridae, Flatidae, Ricaniidae and, perhaps, the Derbidae have only been found in much more recent formations.

While paleontology gives us some positive data as to the presence of certain forms at certain periods, yet the geological record is not nearly complete enough to allow us to accept negative evidence as indicating that other forms did not exist at

those periods. We must use other evidence to support such a proposition. We cannot expect to find much evidence of Coccidae in the geological records, but we can reason from their high specialization that they appeared later than the more generalized Sternorhynchi.

When considering the problems of phylogeny the possibilities and probability of parallel and convergent evolution must be constantly borne in mind. In every large group of animals there is evidence of such, and it is the first work of the phylogenist to decide where this has taken place. For this reason we must not base our conclusions upon one structure alone. But we must base our conclusions upon evidence, even if it be inconvenient. If evidence can be shown that the "filter" was once present in the Cicadellidae and has since been lost, then our task would be simplified; the Membracidae would then come off the same base and the Cercopidae would represent the more direct line. This is indicated by the thickened line in the diagram. But until such evidence can be produced we must take things as we find them and arrange our diagram accordingly.

In drawing up diagrams Nos. 1 and 2 (Plates VII and VIII) I have tried to take the above remarks into consideration. They do not indicate the time element, but simply try to express my conceptions of the morphological affinity of the families dealt with. As such they are liable to alterations and repairs, as they give way beneath the weight of accumulated knowledge.

New or Little-Known Crane-Flies from the Hawaiian Islands (Tipulidae, Diptera).

BY CHARLES P. ALEXANDER, AMHERST, MASS.

(Presented by Mr. Bryan at the meeting of June 3, 1922.)

The following records are based on a collection of Tipulidae kindly sent to me by Dr. James F. Illingworth. The types and uniques are preserved in the collection of the Bishop Museum, Honolulu. The chief papers dealing with the Tipulidae of the Islands are the following:

Grimshaw, Percy. Fauna Hawaiiensis, vol. III, pp. 6-10; 1901.

Alexander, Charles P. Notes on the Crane-Flies of the Hawaiian Islands. Annals Ent. Soc. Amer., vol. XII, pp. 25-30; 1919.

It now appears that the species of *Limnobia, Styringomyia,* and *Trimicra* are more widely distributed than was believed at the time of their original characterization in 1901. The numerous species of *Dicranomyia,* on the other hand, all seem to be endemic. The same is true of the single species of *Gonomyia* known from the Islands.

Limnobia perkinsi Grimshaw.

The following localities are represented:

Oahu: Honolulu, October, 1919 (E. H. Bryan, Jr.).
Fiji: Rewa, March, 1906 (F. Muir).

The species is now known from other Pacific Islands as Samoa and Tahiti. In previous papers, the writer had considered this species as being more properly referable to *Libnotes.* Following the definition of the latter genus as diagnosed by Mr. F. W. Edwards, the present species is to be retained in *Limnobia.*

Dicranomyia stygipennis Alexander.

(*D. brunnea* Grimshaw, preoccupied.)

The following records are available:

Oahu: Kolekole, Waianae, February 29, 1920 (E. H. Bryan, Jr.); Pauoa V., June 17, 1917 (J. C. Bridwell);

Moanalua V., altitude 1200 feet, April 9, 1922 (E. H. Bryan, Jr.).

Maui: altitude 2000 feet, March 19, 1919 (J. A. Kusche).

Kauai: altitude 4000 feet, April 23, 1919 (J. A. Kusche); Kokee, January, 1919 (J. A. Kusche).

The synonymy of *D. brunnea* with *stygipennis* is established by a comparison of paratypes of the two. Grimshaw described the wings as being "hyaline," which is certainly not the case. The present species appears to be the most abundant Tipulid in the Islands.

Dicranomyia grimshawi Alexander.

(*D. apicalis* Grimshaw, preoccupied.)

The following localities are represented:

Oahu: Cooke Trail, April 5, 1919 (O. H. Swezey).

Kauai: altitude 4000 feet, April 23, 1919 (J. A. Kusche); Kokee, March 30, 1919 (J. A. Kusche).

Dicranomyia hawaiiensis Grimshaw.

The following locality is added:

Hawaii: Honaunau, June, 1919 (J. G. Stokes).

Dicranomyia kauaiensis Grimshaw.

This very rare crane-fly is represented by material from near the type-station.

Kauai: Summit Camp, September 2, 1920 (O. H. Swezey).

Dicranomyia foliocuniculator Swezey.

Three specimens from the following stations:

Oahu: Cooke Trail, April 5, 1919 (O. H. Swezey); Moanalua V., altitude 1200 feet, April 9, 1922 (E. H. Bryan, Jr.).

Dicranomyia nigropolita sp. n.

General coloration shiny black; anterior part of vertex and a conspicuous ventral area on thoracic pleura silvery white pubescent; wings faintly infuscated, the stigma conspicuous, dark brown; cell *first M*$_2$ open by the atrophy of *m*.

Male. Length about 3 mm.; wing, 4.6 mm.

Female. Length about 4 mm.; wing, 4.8 mm.

Rostrum and palpi brownish black. Antennae black, the basal flagellar segments subglobular. Head black, the narrow vertex silvery white anteriorly.

Pronotum obscure yellow, blackened medially. Mesonotum shiny black; in some cases the humeral region of the praescutum obscure yellow; lateral margins of the praescutum very narrowly yellowish. Pleura brownish black, shiny, with a conspicuous, ventral, obscure yellow area that is densely covered with a microscopic appressed pubescence that appears like a bloom when viewed obliquely from above; this area extends from behind the fore coxa to dorsal of the mid-coxa. Halteres pale brown, the base of the stem and the knobs yellow. Legs with the fore coxae obscure yellow; mid-coxae yellow, the base extensively infuscated; posterior coxae with the outer face infuscated; trochanters obscure yellow; remainder of the legs black. Wings with a faint brownish tinge; stigma conspicuous, oval, dark brown; veins dark brown. Venation: *Sc* short, *Sc1* ending just before the origin of *Rs*, *Sc2* apparently atrophied; cell *first M2* open by atrophy of *m*; basal deflection of *Cu1* close before the fork of *M*.

Abdomen black, the ventral lobes of the hypopygium brownish yellow.

Habitat.—Hawaiian Islands.

Holotype, male, Kaumuahona, Oahu, November 23, 1919 (E. H. Bryan, Jr.).

Allotype, female, Southeast Koolau Mountains, Oahu, February 11, 1917 (J. C. Bridwell).

Paratypes, female, Wahiawa, Oahu, October 31, 1920 (O. H. Swezey); male, Waihee, Maui, September 4, 1919 (E. H. Bryan, Jr.).

This handsome little fly is readily told by the shiny black coloration and the open cell *first M2*.

Styringomyia didyma Grimshaw.

The following records are available in this material:

Oahu: Central Y. M. C. A., Honolulu, February 16, 1922 (William A. Meinecke); one pair, taken in copula.

Hawaii: Honaunau, August 13, 1919 (O. H. Swezey).

Trimicra pilipes (Fabricius).

Mr. F. W. Edwards believes that most, if not all, of the rather numerous described species of the genus are synonyms or varieties of the common *T. pilipes*. There can be no doubt but that the total number of valid species is much less than has generally been supposed. The Hawaiian records have been listed hitherto as *T. lateralis* Grimshaw. The following observations are available:

Kauai: Kaholuamano, April, 1920 (J. A. Kusche).

Hawaii: Honaunau, June, 1919 (J. G. Stokes).

Undescribed Species of Australasian and Oriental Crane-Flies (Tipulidae, Diptera).

BY CHARLES P. ALEXANDER, AMHERST, MASS.

(Presented by Mr. Bryan at the meeting of July 6, 1922.)

The species herein described as new are from Southeastern China, Papua, and Eastern Australia and were collected by Messrs. Kershaw and Muir, and the late Messrs. R. Helms and F. W. Terry. They were included in the collections of the Bernice P. Bishop Museum and were kindly submitted to me for determination by my friend, Dr. James F. Illingworth, to whom I am indebted for many kind favors.

Genus Gynoplistia Westwood.

Gynoplistia nigrithorax, sp. n.

General coloration black; head reddish; antennae with ten branched segments; wings with a very heavy brown pattern.

Female? Wing, 11 mm.

Rostrum obscure reddish; mouth-parts dark; palpi dark red, paler at the incisures. Antennae reddish, the pectinations dark brown; seventeen-segmented, the formula being 2+2+8+5, the longest pectination (on flagellar segments five and six) about three times the segment; pectination of flagellar segment ten shorter than the segment. Head shiny red.

Pronotum velvety black. Mesonotum subshiny, black throughout; pseudosutural foveae very large, oval in outline. Pleura velvety black. Halteres black, the extreme base obscure reddish. Legs with the coxae and trochanters black, the femora abruptly orange with the tips narrowly infuscated, broadest on the posterior femora, almost obliterated on the fore femora; tibiae orange, the fore tibiae slightly infuscated, the extreme bases and the broader apices darkened; tarsi black. Wings with a faint yellowish tinge, the base and cell *C* more strongly flavous; a very heavy brown pattern, appearing as two broad crossbands, the first broadest, extending from arculus to beyond the level of the origin of *Rs*, interrupted in cell *R* proximad of *Rs* and not including cell *second C* except the base; basal two-fifths of cell *second A* flavous; the second band occupies the level of the cord, is of nearly equal width throughout and completely traverses the wing; wing-apex darkened, restricting the ground-color to a very narrow and ill-defined area across the apical cells; veins dark brown, brighter in the yellow areas. Venation: Cell *M1* longer than its petiole; cell *first M2*

arcuated at its proximal end; basal deflection of *Cu1* about one-third its length beyond the fork of *M*.

Abdomen broken.

Hab.—Papua.

Holotype, female ?, Laloki, New Guinea, November, 1910 (*F. Muir*).

Type in the Hawaiian Sugar Planters' Experiment Station.

Gynoplistia fumipennis, sp. n.

General coloration black, the thoracic pleura dusted with grey; legs black; wings suffused with dark brown; abdomen orange, the terminal two segments and the ovipositor black.

Female. Length, 12.5 mm.; wing, 10.5 mm.

Rostrum and palpi black. Antennae black, the flagellum badly twisted in the unique type so the number of segments cannot be accurately determined. Head shiny black.

Thorax shiny black, the pleura with an appressed microscopic grey pubescence that appears like a bloom. Halteres brownish black. Legs with the coxae black, dusted with grey; remainder of the legs black. Wings with a dark brown suffusion, almost uniform over the entire surface, the costal region only being a little darker, pale longitudinal streaks in cells *R, M, Cu1, first A, second A,* and along vein *M;* veins dark brown. Venation: *r* near tip of *R1;* petiole of cell *M1* very short, about one-half longer than *m;* basal deflection of *Cu1* just beyond midlength of cell *first M2*.

Abdomen bright orange, segments eight and nine shiny black. Ovipositor black, the valves elongate.

Hab.—New South Wales.

Holotype, female, Blue Mountains, December, 1912.

Type in the Bishop Museum.

Gynoplistia helmsi, sp. n.

General coloration greenish black; abdomen violaceous, the third and genital segments reddish; legs black, the femoral bases broadly reddish; wings subhyaline, heavily banded with brown; antennae with not more than seventeen segments, the basal seven flagellar segments pectinate.

Female. Length, 8.8 mm.; wing, 8.2 mm.

Rostrum greenish black; palpi black. Antennae with sixteen or seventeen segments, the formula being 2+2+5+7 (or 8), black. Head greenish black.

Mesonotum greenish black, shiny. Pleura black, dusted with whitish. Halteres yellow. Legs with the coxae black, dusted with white; trochanters black; femora black with the basal half or less reddish, the tips somewhat clavate; remainder of the legs black; posterior legs lost. Wings sub-

hyaline, the base yellowish; cell *C* light brown, *Sc* dark brown; a heavy brown pattern distributed as follows: bases of cells *R* and *M*, continued into cells *Cu* and *first A*; a large, quadrate area at origin of *Rs*, barely reaching *M;* a crossband extending from the stigma across the wing along the cord, leaving a pale spot in cell *first M2;* wing-tip rather narrowly dark brown, including the distal two-fifths of cells *R2*, *R3*, and *R5;* all of *M1* and the extreme tip of *second M2;* a brown cloud beyond mid-length of cell *second A;* veins brown, yellow at the base of the wing. Venation: Cell *second R1* very small, triangular; cell *M1* about as long as its petiole; basal deflection of *Cu1* at about one-third the length of cell *first M2*.

Abdomen violaceous, the third segment reddish. Ovipositor elongate, orange, the tips darkened.

Hab.—New South Wales.

Holotype, female, Blackheath, January, 1904 (*R. Helms*).

Type in the Bishop Museum.

This species is dedicated to the memory of the collector.

Genus Eriocera Macquart.

Eriocera praelata, sp. n.

Male. Length, 24 mm.; wing, 24 mm.

By Edwards' Key to the Old World species of *Eriocera*, the present species runs down to *E. mesopyrrha* (Wiedemann), from which it differs as follows:

Size very large, one of the largest species of the genus known. Antennal scape dark brown, the flagellum obscure yellow, the terminal segments darker. Head dark brown, the vertical tubercle small, conical. Mesonotal praescutum rich reddish brown, the remainder of the mesonotum darker; scutellum conspicuously protuberant. Pleura brown. Legs with the fore and middle femora reddish brown, the tips narrowly infuscated; posterior femora dark brown, the bases brighter. Wings rich brown with a broad but diffuse yellowish crossband, this lying mostly proximad of the cord; base of anal cells similarly brightened; distal third of costal region dark brown; the yellow discal band includes the bases of cells *R3* and *first M2;* veins pale brown. Venation: *Rs* spurred at origin; *r* about one and one-half times its length beyond the fork of *Rs; M2* shorter than the petiole of cell *M1;* vein *second A* strongly sinuous, bent strongly toward vein *first A* at the tip so the large cell *second A* is narrower at the margin than is cell *Cu*. Abdomen rich reddish brown, segments one and five to nine brownish-black, the caudal margins of tergites two to four narrowly darkened; basal half of tergite two shiny; hypopygium black.

Hab.—China.

Holotype, male, Macao (*F. Muir*).

Type in the Hawaiian Sugar Planters' Experiment Station.

Eriocera muiri, sp. n.

General coloration black; wings brown, cells *C* and *Sc* yellow; a very broad yellow crossband before the cord; abdomen black, the basal halves of the tergites scoriaceous.

Male. Length, 14 mm.; wing, 14.5 mm.

Rostrum and palpi dark brown. Antennae dark brown, the terminal flagellar segments broken, the basal flagellar segments a little paler than the scape. Head dark brown.

Mesonotum dark brown, with three almost concolorous smooth stripes; scutellum and postnotum shiny dark brown, the scutellum projecting. Pleura shiny dark brown. Halteres rather short, dark brown, paler basally. Legs dark brown. Wings brown; cells *C* and *Sc* yellow; wing-apex broadly darker brown; a very broad yellow crossband, lying almost wholly proximad of the cord; veins dark brown, those in the yellowish areas paler. Venation: *r* on *R2* about one and one-third times its length beyond the fork of *Rs;* cell *M1* present; vein *second A* sinuous, cell *second A* at wing-margin a little narrower than cell *Cu;* cell *second A* large.

Abdominal tergites bicolorous, the base of each segment scoriaceous, liliaceous brown, the apical half velvety black; hypopygium dark; sternites more uniformly brown.

Hab.—China.

Holotype, male, Macao (*F. Muir*).

Type in the Hawaiian Sugar Planters' Experiment Station.

This interesting *Eriocera* is named in honor of the collector, Mr. Frederick Muir. By Edwards' Key, this species runs out at couplet seventy-one by the combination of scoriaceous crossbands on the abdominal tergites and the presence of five posterior cells.

Eriocera obliqua, sp. n.

Female. Length, 15-16 mm.; wing, 14-14.5 mm.

Allied to *E. nepalensis* (Westwood), from which it differs as follows:

Wings with the base not at all brightened; the white band before the cord broadest in cells *R* and *M*, narrowed at the ends. Venation: *r* very oblique as in this group of species, inserted at or before the fork of *R2+3*. Ovipositor with the base black, only the valves dark horn-colored.

Hab.—China.

Holotype, female, Macao (*F. Muir*).

Paratopotypes, two females.

Type in the Hawaiian Sugar Planters' Experiment Station.

The general appearance of this fly is more like *E. hilpa*

Walker and allies (*hilpoides* Alexander, *davidi* Alexander, etc.), from all of which it is readily told by the position and course of *r*.

Eriocera terryi, sp. n.

Male. Length, 12.8 mm.; wing, 11.5 mm.

Female. Length, 15 mm.; wing, 12.4 mm.

Related to *E. geminata* Alexander (Japan), differing as follows:

Antennae of the male longer, with long and conspicuous setae. Thoracic stripes black, almost concolorous with the interspaces. Legs brownish-black throughout. Wings with the discal pale band larger, oblique in position and pale yellow in color, only a little paler than the paired spots in cell *R;* the discal band extends from cell *Sc1* across cells *second R1*, *R*, and *M*, barely attaining cell *Cu;* a pale area in the center of cell *Cu1*. Venation: *r* approximately its own length beyond the fork of *R2+3* and twice its length from the tip of *R1;* fork of vein *Cu* forming a greater angle; basal deflection of *Cu1* at or before midlength of cell *Cu1*. Ovipositor and genital segment fiery orange.

Hab.—China.

Holotype, male, Hongkong, 1908 (*F. W. Terry*).

Allotopotype, female, in copula with the type.

Type in the Hawaiian Sugar Planters' Experiment Station.

This interesting species is named in memory of the collector, the late Mr. F. W. Terry. By Edwards' Key, it runs out at *E. hilpa* Walker, to which group of species it should be referred.

Eriocera submorosa, sp. n.

General coloration black; vertical tubercle deep red; wings brown; cell *M1* lacking; abdominal tergites with alternate opaque and shiny cross-bands.

Male. Length about 12.5 mm.; wing, 12.2 mm.

Rostrum and palpi dark brown. Antennae with the scape brown, the flagellum black; antennae, if bent backward extending beyond the base of the abdomen. Head black, the region of the vertical tubercle deep red with a small, circular black spot.

Pronotum dark brown medially, paler laterally. Mesonotum velvety black. Pleura brownish black. Halteres dark brownish black. Legs brownish black throughout. Wings strongly tinged with brown, somewhat darker at the base and in the costal region; veins dark brown. Venation: *Sc1* ending beyond the fork of *R2+3; r* on *R2* about two and one-half times its length beyond the fork and on *R1* nearly four times its length from the tip; cell *M1* lacking; cell *first M2* rectangular; basal deflection of *Cu1*

before midlength of cell *first M*2; *Cu*2 about one-half the length of the basal deflection of *Cu*1.

Basal abdominal tergite velvety black; segments three to seven more dilated and with the basal two-thirds of each segment shiny, glabrous, somewhat glaucous; hypopygium black; sternites deep reddish brown.

Hab.—China.

Holotype, male, How-lik Mountains, 1907 (*Kershaw*).

Type in the Hawaiian Sugar Planters' Experiment Station.

Genus Pselliophora Osten Sacken.

Pselliophora kershawi, sp. n.

General coloration orange; wings yellow, the apex dark brown; wing-base variegated with paler brown; eighth sternite of male hypopygium not projecting.

Male. Length, 19 mm.; wing, 15.5 mm.

Female. Length, 25 mm.; wing, 19 mm.

Rostrum reddish; palpi reddish brown. Antennae orange, the terminal segments darker; all flabellations black; pectination of first flagellar segment in the male stout, orange; antennae of female orange, the terminal three segments minute. Head orange.

Thorax entirely orange, immaculate. Halteres orange, the knobs a little darker. Legs with the coxae and trochanters concolorous with the thorax; femora obscure orange, the posterior femora with the tips conspicuously infuscated; tibiae orange, the posterior tibiae with a broad but diffuse pale annulus at base; metatarsi brownish orange, the terminal segments brown. Wings yellow, the apex beyond the cord dark brown, this including the distal half of the stigma; the yellow base is extensively suffused by paler brown, including a very broad, oblique crossband, broadest in cells *R* and *M*, narrower in cells *Cu* and *first A;* cell *second A* and the caudal margin of *first A* entirely dark; the yellow ground-color appears as a broad, conspicuous band completely traversing the wing before the cord and a narrow longitudinal area in the bases of cells *Cu* and *first A*, on either side of vein *first A*, continued across cell *first A* to the margin near the tip of vein *second A*. In the male the brown basal pattern is somewhat less intense, especially in cells *R* and *M*, and the base of cell *second A* is yellow. Venation: Cell *M*1 barely sessile; *m-cu* long.

Abdomen orange; caudal margin of ninth tergite of male and the ovipositor of the female black. Male hypopygium with the ninth tergite having an oval median notch, the lateral lobes obliquely truncated, with the caudal face tumid, heavily blackened, the surface microscopically roughened. Ninth sternite with two flattened mesal plates, each terminating in an acute spine directed dorsad, the caudal margin of the plates lying side by side, the ventral mesal angle produced caudad into a chitinized rod

which is directed ventrad, the apex feebly bilobed. Eighth sternite not produced.

Hab.—China.

Holotype, male, How-lik Mountains, 1907 (*Kershaw*).

Allotopotype, female.

Type in the Hawaiian Sugar Planters' Experiment Station.

This interesting species of *Pselliophora* is dedicated to the collector.

GENUS HABROMASTIX SKUSE.

Habromastix heroni similior, subsp. n.

Male. Length, 15 mm.; wing, 18 mm.; antenna, 19 mm.

Female. Length, 21 mm.; wing, 17 mm.; antenna, 6.5 mm.

Generally similar to *H. heroni* Alex. (Dorrigo, New South Wales), differing in the wing-pattern, as follows:

Pale ante-stigmal area in costal cell small or lacking; the distal pale area in cell *M* completely traverses the cell from vein *M* to *Cu* (in *heroni* confined to the vicinity of vein *Cu*); center of cell *first M*^{2} usually pale. Venation: *Rs* shorter; cell *M1* short-petiolate, sometimes sessile.

Hab.—New South Wales.

Holotype, male, Sydney, March, 1910 (*R. Helms*).

Allotopotype, female, April 10, 1909 (*R. Helms*).

Paratopotypes, two males, April 15-20, 1909.

Type in the Bishop Museum.

Other Malayan, Oriental, and Australasian Crane-Flies.*

In addition to the foregoing new species of Tipulidae described by Professor Alexander, the following species from the same collections were determined by him. Specimens in the Bishop Museum.

AUSTRALIA, HELMS COLLECTION.

Gynoplistia melanopyga Sch., Sydney, N. S. W.
Gynoplistia bella (Wh.), Sydney, N. S. W.
Ptilogyna ramicornis (Wh.), Centennial Park.
Leptotarsus scutellaris Skuse, Blackheath, N. S. W.
Pseudolimnophila indecora Al., Perth, W. Aust.

* List furnished by E. H. Bryan, Jr.

Macromastix constricta Skuse, Sydney, N. S. W.
Macromastix costalis (Swed.), Sydney, N. S. W.
Ischnotoma serricornis (Macq.), Sydney, N. S. W.
Ischnotoma rubroabdominalis (Macq.), Millthorpe, N. S. W.
Discobola australis (Skuse), Ourimbah, N. S. W.
Trimicra hirtipes (Wh.), Sydney, N. S. W., Perth, W. Aust.
Plusiomyia gracilis (Wh.), Sydney, N. S. W.
Gnophomyia fascipennis (Thom.), Sydney, N. S. W.
Dolichopeza cinerea Macq., Sydney, N. S. W.
Dolichopeza longifurca Skuse, Sydney, N. S. W.
Dicranomyia sp., Sydney, N. S. W.

MALAYAN AND ORIENTAL.

(Collected by F. Muir, except where otherwise noted.)

Eriocera chrysomela Edw., Lo fou Mountains (100-1000 feet), China.
Eriocera nepalensis West., Lo fou Shan (100-1000 feet), China.
Eriocera basillaris Wd., Java.
Eriocera paenulata End., Sandaglaija, Java.
Eriocera perennis O. S., Los Banos, Philippine Islands (Williams).
Ctenacroscelis sp. (locality not given).
Trentepahlia (*Mongoma*) sp., Amboina material, S. S. Tjibodus.
Conosia irrorata (Wd.), Kowloon (Terry).
Pselliophora gaudens (Walker) Makassar (S. W. Celebes).
Pselliophora tripudians Bezzi, Los Banos, Philippine Islands (Williams).
Pselliophora sp., Macao Island, China.
Tipulodina sp., Macao Island, China.
Nephrotoma sp., Macao Island, China.
Nephrotoma sp., Amboina.

Other papers by Charles P. Alexander on the Crane-flies of these regions are:

1917. Two New Crane-flies from the Philippine Islands, Inscutor Inscitiae Menstruus, V, pp. 6-8.

1918. New Species of Tipuline Crane-flies from Eastern Asia. Journal New York Ent. Soc., XXVI, pp. 66-75.

1922. New or little-known Tipulidae (Diptera). Australasian Species.
VIII. Ann. & Mag. of Nat. Hist. (9), IX, pp. 145-160.
IX. Ann. & Mag. of Nat. Hist (9), IX, pp. 297-315.
X. Ann. & Mag. of Nat. Hist. (9), IX, pp. 505-524.

1922. Undescribed Crane-flies (Tanyderidae and Tipulidae) in the South Australian Museum, No. 2.
Records of the South Australian Museum, II, No. 2, pp. 223-270.

Descriptions of Lantana Gall-Fly and Lantana Seed-Fly (Diptera).

BY DR. J. M. ALDRICH,
U. S. NATIONAL MUSEUM.

(Presented at the meeting of February 2, 1922.)

LANTANA GALL-FLY.

Eutreta xanthochaeta new species.

Male. Very similar to *Eutreta sparsa* Wd., except that the bristles of the head and thorax are all pale yellow in color. Head brownish yellow, the front with numerous flattened whitish hairs, of which a row in front of the ocellar triangle are turned backward; a very distinct black spot on the orbit at the level of the first antennal joint; face with two large round black spots; antennae yellow, including the arista. Palpi yellow, the hairs at the tip blackish.

Thorax brownish yellow. Mesonotum covered with flattened, pale yellow hairs; pleura of the same color, with a darker stripe just above the sternopleura; metanotum black, opaque. Abdomen reddish yellow at base, especially on the sides, the first segment elongated, second and third with a transverse dark spot, the fourth mostly black. Hypopygium small, reddish. The hairs of the abdomen are black where the ground color is black. Legs yellow, the femora slightly infuscated, especially on the lower edges; the front femora with an irregular double row of short, yellow bristles above, and on the lower outer side a row of four or five longer yellow bristles which begin at the middle.

Wings broad, but not circular in outline, deep brownish in color, sprinkled with numerous small, whitish dots; the costal edge is white throughout, but very narrowly so, with an undulating border where it joins the darker color. This pale border becomes wider and more uniform beyond the tip of the second vein and ends a short distance beyond the fourth vein; from this point around the hind border of the wing there are about twelve somewhat equally spaced white dots of which the first three or four rest on the margin.

Female. Ovipositor broad at base, about as long as the two preceding segments varying in color from reddish brown to black. Darker specimens show two dark spots close together below the eye, the lower one joining the edge of the mouth and also a median spot at the edge of the mouth.

Length of male, 5.1 mm.; of female, including ovipositor, 6 mm.

Described from twelve specimens of both sexes bred from Lantana in the Hawaiian Islands.

Type. Male, Cat. No. 25,203, U. S. Nat. Mus., Honolulu,

March 18, 1918, O. H. Swezey, Collector. Paratype specimens will be deposited in the collection of the Experiment Station of the Hawaiian Sugar Planters' Association and in the Bernice Pauahi Bishop Museum, Honolulu.

Although this species is an importation from Mexico, there are no specimens in the National Museum from any part of the American Continent which have pale bristles. Hendel in Abhandlungen und Berichte des Konigl. Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden, Band XIV (1912), p. 54, published June 15, 1914, has given a synopsis of the South American forms belonging to this genus, none of which agrees with the present species.

Lantana Seed-Fly.

Agromyza lantanae * Froggatt.

A minute shining black species, with black halteres, the male having very strong up-curved vibrissae.

Male. Front one-third the head width; orbits very narrow, slightly shining, with four bristles; ocellar triangle shining, a little elongated. Antennae black, small, inserted below the middle of the eyes, a very distinct prominence between them. Facial orbits very narrow, hardly visible; the cheek about one-sixth the eye-height, slightly wider anteriorly where it is a little produced and bears on each side a large bristle or, more correctly, a pencil of hairs which are glued together. This pencil is quite slender at the base and consequently much less tapering than in *curvipalpis* Zett., *coniceps* Malloch and *affinis* Malloch. Palpi small, black. Mesonotum with two pairs of dorso-centrals, the small hairs covering the surface extending almost to the scutellum; the latter has four large bristles. Pleura shining black. Halteres black, calypters brown with blackish margin bearing a dense row of short black hairs. Abdomen shining black without any blue or green reflection, not highly polished. Legs entirely black.

Wings subhyaline, narrow at the apex, but widening rapidly toward the base and with a well-developed nearly square anal angle. The anterior cross-vein is barely beyond the tip of the first vein and at about two-

* This name was first used by Froggatt in a paper on the Lantana Fly in the Agricultural Gazette of New South Wales, XXX, pp. 665-668, 1919, with the impression that the insect had been previously described under that name. Froggatt gave a very brief description of the fly, not intended as a technical description, and entirely inadequate to distinguish the species. Hence, the advisability of the present description, although the name *lantanae* must be accredited to Froggatt.

thirds of the length of the discal cell. The hind cross-vein a little longer than the preceding section of the fourth vein, about two-thirds as long as the last section of the fifth vein. The costa extends to the fourth vein.

Female. Oral margin only a little produced with a single small vibrissa on each side. Ovipositor short, shining black with numerous hairs, the apical ones as long as any of the abdomen.

Length, 1.5 mm. in both sexes.

Described from thirty-three specimens of both sexes bred from seeds of lantana in the Hawaiian Islands by O. H. Swezey.

I identified this species a few months ago as *Agromyza affinis* Malloch, a species which was described from a single female taken in the vicinity of Washington, D. C. Mr. Malloch doubtfully associates with this female two males from Key West, Fla. I have recently succeeded in identifying the true male of *affinis* from approximately the latitude of Washington. I find that it differs from the male of *lantanae* in having the cluster or pencil of vibrissal hairs much more thickened at the base; that is, apparently part of these hairs are short so they only increase the size of the cluster at the base. I am still unable to see any satisfactory characters for separating the two species in the female sex, but since lantana does not grow at Washington, *affinis* must have an entirely different larval habit, which would tend to confirm their distinctness. Mr. J. C. Bridwell has submitted a series of twelve specimens of an *Agromyza* which he bred from *Lantana camara* at Brownsville, Tex., in April and May, 1921. The specimens are badly denuded, but I do not doubt that they are the same species.

Four specimens sent by Dr. J. F. Illingworth from Gordonvale, North Queensland, where they were bred from lantana, are also the same species. I also include here the two males from Key West, Fla., mentioned by Malloch in connection with his description of *affinis*.

Notes on Diptera Occurring in Hawaii.

BY J. F. ILLINGWORTH.

(Presented at the meeting of February 2, 1922.)

Comparatively little has been published on Hawaiian Diptera. The rather extensive investigations of Terry, while doing much to aid local entomologists in a knowledge of many species, was unfortunately cut short by his untimely death; hence, few of his data were ever published.

In this paper it is my desire to submit accumulated information on two of our commonest flies, and also add a few remarks on several other species listed in the Fauna Hawaiiensis, but not known in collections here. Most of the matter dealing with terminology has come through the kindly assistance of Dr. J. M. Aldrich, of the United States National Museum, Dr. Guy A. K. Marshall, of the British Museum, and Major W. S. Patton, of Edinburgh University, the latter having visited the principal type collections of Europe during the summer.

Synthesiomyia nudiseta (Van de Wulp), det. by Patton.

Cyrtoneura nudiseta Wulp, Argentine Republic.
Synthesiomyia brasiliana B. & B., Brazil.

This American species is evidently a rather recent arrival in the islands. Terry did a lot of breeding work on it in 1910, and though I first collected it in Fiji (June, 1913), I found it abundant here as soon as I began breeding carrion flies, early in 1914. At that time this species went under the common name of the red-tailed Sarcophagid, as designated by Bridwell,[1] who had done some breeding work with the species, and discovered that the larvae made cocoons in sand. My Fiji specimens were determined by Aldrich as *S. brasiliana* B. & B. and, I believe, Bridwell, too, so determined it, for he used this name in his paper,[2] presented before the Medical Society here.

Proc. Haw. Ent. Soc., V, No. 2, September, 1923.

[1] Bridwell, J. C., Proc. Haw. Ent. Soc., vol. 3, p. 15 (September 4, 1913), 1914.

[2] Bridwell, J. C., Trans. Med. Soc. Hawaii, for 1916-17, pp. 27-32, 1918. (See, also, Rev. Appl. Ent. Ser. B., vol. 6, pp. 163-4, 1918.)

I found this species very localized in Australia, apparently occurring only around Brisbane. After my return to Honolulu, I sent specimens to Patton, who found that this was Van der Wulp's species ***nudiseta,*** originally described from Argentine Republic, in 1883.[3] He placed it in Macquart's genus *Cyrtoneura,*[4] which was characterized by having the antennal bristle thickly feathered. However, in 1893, Brauer and Bergenstam, securing specimens from Brazil, named the species ***brasiliana*** and were compelled to create the new genus *Synthesiomyia*[5] for it. Other localities on record for it are Florida and Georgia.[6] [7]

At a previous meeting I called attention to the very peculiar manner in which the maggots congregate so compactly side by side, that a cross-section of the mass of hair and dirt from the carcass, in which they are imbedded, gives the appearance of old honeycomb.

In breeding out these flies on a dead rat, I found that the maggots were considerably slower in getting started than either those of *Sarcophaga fuscicauda* Bött. or *Chrysomyia megacephala* (Fab.); being more closely associated, when ready to pupate, with the larvae of *Ophyra nigra* Wied. These two latter species both have smooth shiny maggots, but those of *S. nudiseta* have conspicuous black caudal spiracles, whereas those of *O. nigra* are brown in color, making them easy to separate.

Chrysomyia megacephala (Fabr.), det. by Patton.

Musca megacephala Fabr. Ent. Syst., vol. IV, p. 317, 1792.
Musca dux Eschscholtz, Entomographien, 1822, p. 114.
Lucilia dux Wiedemann, Auss. Zweifl., vol. II, p. 399, 1828.
Lucilia flaviceps Macquart, Dip. Exot., 3d Sup., p. 302.
Musca remur Walker.

This oriental species was probably an early introduction into

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[3] Wulp, F. M. Van der, Amerikanische Diptera; Tijdschr. Ent., vol. 26, p. 42. Also noted, Zool. Record, 1883, Ins., p. 248.

[4] Macquart, M. J., Suit a Buffon, vol. 2, p. 13, 1835. Description of the genus *Cyrtoneura* (*Curtoneura*).

[5] Brauer, Friedrich and Bergenstam, J. E. von, Zweifl. d. Kaiserl. Mus., vol. 6, pp. 96, 110, et seq., 1893.

[6] Hough, G. de N., Biol. Bull., vol. 1, p. 29, figs.

[7] Johnson, C. W., Proc. Acad. Nat. Sci. Philadelphia, p. 335, 1895. Johnson, C. W., Bull. American Mus. Nat. Hist., vol. XXXII, p. 76, 1913.

the Islands. Hence, here, as well as elsewhere, it has gone under a variety of names. Van Dine got it determined in the United States National Museum, in 1907, as *Calliphora dux* (Esch.), and, in 1909, Terry determined it as *Lucilia dux* (Esch.). Early in 1916, Swezey sent specimens to the United States National Museum, and these were determined by Knab as *Chrysomyia dux* (Esch.). Now, Patton has compared our specimens with the type and cleared up the synonymy. In his letter of September 10, 1922, he says: "I went to Kiel and found that the whole of Fabricius' collection of Diptera was destroyed, only pins left. Fortunately his type of *megacephala* was not completely gone and I was able to recognize it. At the back of the label were the words 'Ex. Ind. Or.' This finally disposes of this species. The type came from India and not from West Africa. *Ch. flaviceps* Macq. is the same species, as is also *Musca dux* Esch."

The distribution of this species is extremely wide, extending from India, probably its native home, to Hawaii. Muir collected it in China, Borneo, and Java, and Fullaway took specimens in Guam, Eschscholtz's type locality. It is also found in New Hebrides and Australia. I saw a male specimen taken near Sydney, in the Australian Museum, and a male has just been forwarded in a collection from New Hebrides.

It breeds in all kinds of animal matter, and has been recorded repeatedly as a sheep-maggot fly in Hawaii. The adults are particularly fond of sweets, and are frequently found in swarms in fields of corn affected by leaf-hoppers, where they feed upon the honey dew.

Lucilia caesar Linn.

This widespread carrion species probably does not occur in Hawaii. The basis for including it in our fauna has been Howard's record [8] of three specimens collected by Henshaw, on the island of Hawaii. No one has collected *caesar* here subsequently, so I asked Dr. Aldrich to try to locate these specimens in the United States National Museum collection and clear the matter up. May 20, 1922, he wrote: "I find no Hawaiian specimens under this species in the collection, but there are three specimens collected by Henshaw, April 16, 1900, correctly placed under *Lucilia sericata*. Inasmuch as Howard did not mention

the latter species, I think there is little doubt that his reference was a misidentification which has been corrected since then."

Ophyra leucostoma (Wied.).

This is another European species probably incorrectly referred to our fauna. The single record is the female specimen from the Waianae Mountains, Oahu, in the Henshaw Collection, recorded by Howard.[8] Dr. Aldrich wrote that he looked through the material under *Ophyra leucostoma,* but found none from Hawaii. He says, "Our Anthomyid material has been sorted over repeatedly and I presume the specimen has been transferred to another species."

I wrote Dr. Marshall, of the British Museum, November 15, 1922, as follows:

"Going over Diptera, we found a number of records in the Fauna Hawaiiensis which are probably errors; hence, to clear these up may we ask you to see if the following specimens can be located, and if they stand under these names.

"*Leucostoma analis* Meigen ?, Fauna Hawaiiensis, vol. 3, p. 20.

"*Calliphora azurea* Fln., Fauna Hawaiiensis, vol. 3, p. 27.

"*Ophyra aenescens* Wied., Fauna Hawaiiensis, vol. 3, p. 30.

"*Phora* sp., Fauna Hawaiiensis, vol. 3, p. 76.

"(We are sending you specimens of *Aphiochaeta scalaris* to compare with this headless specimen.)

"*Rhinia testacea* Desv., Fauna Hawaiiensis, vol. 3, p. 83.

"*Homalomyia femorata* Loew, Fauna Hawaiiensis, vol. 3, p. 84.

"*Sapromyza* sp., Fauna Hawaiiensis, vol. 3, p. 85."

In reply, December 16, 1922, Dr. Marshall wrote:

"With regard to the Diptera in the 'Fauna Hawaiiensis,' mentioned in your letter, all of these are in the British Museum under the names you give, with the exception of the *Phora,* which appears to have been lost. I, therefore, am unable to compare your specimens of *Aphiochaeta scalaris* with it.

"Major Austin informs me, however, that the fact that these insects have been incorporated in the collection under these names is no guarantee that the names are correct, as Grimshaw's identifications have not been checked. He thinks the

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[8] Howard, L. O., Proc. Ent. Soc., Washington, vol. IV, p. 490, 1901.

specimen labeled *Leucostoma analis* Mg. is probably not that species, but is very closely allied to it."

Major Patton, remarking recently on Grimshaw's record of *Calliphora azurea*, suggests, though he had not seen the specimen, that it is almost certainly *Chrysomyia megacephala*.

Insect Fauna of Hen Manure.

BY J. F. ILLINGWORTH.

(Presented at the meeting of April 6, 1922.)

During 1916 the writer, while making some studies of the stick-tight flea (*Echidnophaga gallinacea* Westw.) upon poultry, became interested in the swarms of insects which were observed in and about the manure that had been removed from the hen-houses. In this instance, the droppings had been collected and stored in old kerosene tins, preparatory to placing on the garden. These stood in the open, so had collected considerable moisture from rains, etc., and in a few tins the contents had even become saturated. Yet conditions appeared to be ideal for the development of insects, for even these supersaturated contents were a writhing mass of larvae of various Diptera, etc., together with the various forms of predators and parasites that had gathered around to prey upon them.

Since all exact information of the breeding habits of insects is valuable for reference, the writer thought it well to record all of the organisms that came under these observations. Naturally with the Hawaiian fauna, the great majority of dung-feeding insects are Diptera. Twelve species of flies were bred out from this material. Of the natural enemies of these—predators and parasites—I was able to note fully twenty species.

DIPTERA REARED; GIVEN IN THE ORDER OF ABUNDANCE.

1. *Sarcophaga fuscicauda* Böttcher.—This species I found also in North Queensland, where it proved exceedingly troublesome about human habitations, breeding upon any available food or excrement. Its association with man in the tropics is almost as close as that of the house-fly, *Musca domestica* Linn., though it is more of an outdoor species, living primarily about camps, etc. Like the house-fly, too, this species is quick to follow along the lines of commerce, the indications being that it came to Hawaii either from Australia or from other Pacific countries to the west, during rather recent times. The earliest specimens in collections here bear date of 1905. Dr. R. R.

Parker identified this species for Mr. Timberlake early in 1919. I sent a lot of Sarcophagids from North Queensland to Parker, February 9, 1918, and he also found this species among them.

Even in the semi-liquid manure, the larvae appeared perfectly happy; yet, when full fed, they died if they were unable to migrate to a fairly dry situation.

2. *Musca domestica* Linn., the house-fly.

3. *Stomoxys calcitrans* Linn., the stable-fly.

4. *Ophyra nigra* Wied.—These shining black Anthomyids also appear to be closely associated with man in the tropics, for they are widely distributed. They are very abundant in Queensland, principally as carrion feeders; and are regarded as one of the sheep blow-flies.

The larvae have a characteristic smooth, shiny appearance, and the caudal spiracles are particularly small and brown in color. Unlike the house-fly and stable-fly, the larvae of this species were found to pupate right in the excessively moist manure, from which they were able to emerge successfully.

Mr. Frederick Knab of the United States Museum determined specimens for Mr. Swezey, early in 1916; and also determined a lot which I sent from the College of Hawaii about the same time. Later (March 22, 1918) Dr. Aldrich found that specimens, which were bred and collected in North Queensland, also belonged to this species. Described from China, and being widely distributed in the Orient, introduction to Hawaii was evidently through shipping. The earliest reference to the species here is probably that in the Fauna Hawaiiensis, where two females taken during 1893 and 1894 are placed in the genus *Hydrotaea* Desv. The earliest specimens that we find in collections here are dated Hawaii, February 28, 1905, taken by Terry.

5. *Fannia pusio* Wied.—The larvae of this smaller, omnivorous Anthomyid also swarmed in the semi-liquid manure; yet, like the Sarcophagid, I found that it was necessary for them to get a fairly dry place to pupate, in order to emerge successfully.

6. *Milichiella lacteipennis* Loew.—This tiny Agromyzid occurred in great swarms, with three other undetermined species, about the tins of manure. All three species were later bred out from the mass.

7. An undetermined Mycetophilid (No. 20) also bred out in considerable numbers. This is the tiny fly that is so troublesome, coming into houses to the lights, especially when one is reading in the evening. Their small size permits them to pass through ordinary mosquito screens.

8. *Lucilia sericata* Meig.—I was surprised to have this carrion-fly breed out, even in small numbers, from the hen manure; for knowing the habits of this species I naturally assumed that the numerous individuals swarmed about the manure-tins only to feed. This common English blow-fly has gradually extended its range round the world. It probably got to Hawaii some time about 1900, the first specimens in collections here being dated 1904, by Terry.

9. *Euxesta annonae* Fabr.—This well known Ortalid bred out of the manure in limited numbers. Though I frequently saw the adults sitting about on the surface while the mass was fermenting, I was not able to identify any of their young. The earliest Hawaiian record, that I have been able to locate, of this species, is in the Fauna Hawaiiensis, a female specimen taken in the Honolulu mountains, 1900.

Natural Enemies of Diptera Found in the Manure.

Predators were abundant all the time that the dipterous larvae were developing in the manure; on the other hand, parasites were little in evidence (due to their small size), yet they finally emerged in considerable numbers from the pupae of the flies.

Two species of earwigs were common during the earlier stages, *Euborellia annulipes* (Luc.) and *Spingolabis hawaiiensis* (Borm.). A few of a third, a small species, *Labia pilicornis* (Motsch.), were also captured.

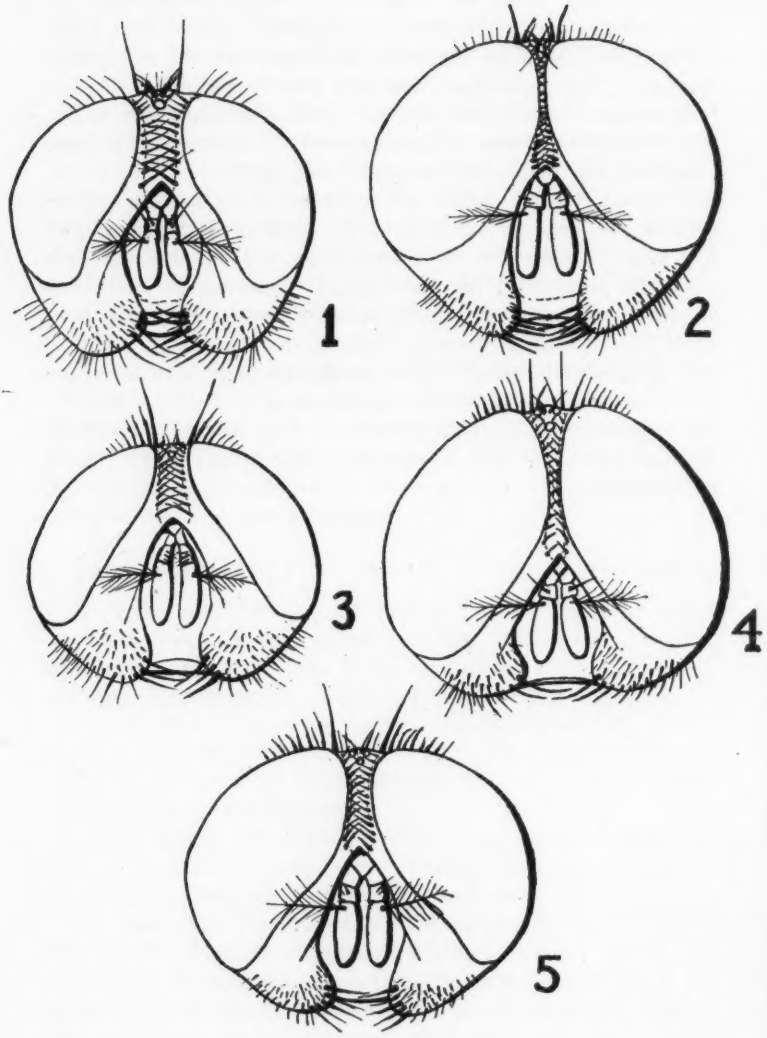
The common Hydrophilid, *Dactylospermum abdominale* (Fabr.), was active, and I also secured specimens of *Cryptopleurum minutum* Fabr. and another small undetermined species.

Four species of Staphylinids were abundant during the earlier part of the work, *Philonthus longicornis* Steph., which Mr. A. M. Lea of the South Australian Museum informs me is the correct name for our *P. scybalarius*, which is a synonym; *Philonthus discoideus* Grav.; a species of *Tachyporus;* and a small *Oxytelus* sp.

Ants swarmed over the surface of the manure and burrowed in where they found the mass dry enough, seeking both the eggs and the larvae of the flies. *Pheidole megacephala* Fabr. proved most useful in this work, attacking even the full grown maggots; *Ponera perkinsi* Forel was also in evidence.

Mites gave considerable distress to the flies when they began to emerge, their bodies being frequently so covered with these predators that they could scarcely move about.

At least seven species of hymenopterous parasites were secured, as they emerged from the various dipterous pupae. The large Cynipid, *Eucoila impatiens* Say, apparently came only from the puparia of the Sarcophagid; Spalangiids were very abundant, at least four species being present; *Spalangia cameroni* Perk., *S. philippinensis* Full., *S. simplex* Perk., and one that is apparently new. Of the remaining, there were two species of *Diapria* and a few *Pachycrepoideus dubius* Ashm. The determinations of these Hymenoptera were kindly supplied by Mr. Fullaway and Mr. Timberlake; they are all fairly recent introductions.



House Flies.

House-Flies.

BY J. F. ILLINGWORTH.

(Presented at the meeting of November 2, 1922.)

Attempting to straighten out the terminology of our Muscoid flies, particularly those records of specimens not recognized in collections here, some interesting observations have come to my notice. Apparently the common house-fly, *Musca domestica* Linn. of Europe, North America, etc., does not occur here, at least not in its typical form. Collecting thousands of flies, during the past decade, has failed to disclose a single specimen.

I have on exhibition typical *domestica* from San Francisco and Mojave Desert, Cal.; Ithaca, N. Y.; and Sydney, Australia. It is to be noted that, in comparison with these, where the eyes of the males are well separated, most of the Hawaiian specimens have the eyes, in that sex, almost contiguous, with some variations.

There is a record of *Musca flavinervis* Thomson in the Fauna Hawaiiensis, which has troubled me, since no specimens have been recognized in collections here. During the voyage of the

Proc. Haw. Ent. Soc., V, No. 2, September, 1923.

PLATE IX.

FACE VIEW OF MALE HOUSE-FLIES.
(Semi-diagrammatic, Camera Lucida sketches.)

EXOTICS.

Fig. 1. Typical *Musca domestica* Linn., from Mojave Desert, Cal., 1916, Illingworth collector.

Fig. 2. Typical *Musca flavinervis* Thomson, from Cape Town, South Africa, Bridwell collector.

HAWAIIAN VARIETIES.

Fig. 3. Nearest approach to *Musca domestica* of all the flies taken. Oahu, January 2, 1914, Illingworth collector.

Fig. 4. Nearest approach to *Musca flavinervis* of all the flies taken. Puna, Hawaii, March 13, 1922, Swezey collector.

Fig. 5. An intermediate form which is representative of the Hawaiian house-flies. University of Hawaii Farm, October 17, 1922. Illingworth collector.

Eugenia, 1851-3, the specimens which Thomson described were collected on Ross Island, on the coast of China (?), and he further stated that a variety was taken at Honolulu. I have typical specimens, which I take to be this species, from Cape Town, collected by Bridwell, and it is very interesting to note that the common house-flies of Hawaii compare more closely with these than with specimens of the true *domestica*. It will further be seen that there is some variation in the width of the space between the eyes of the males in the Hawaiian flies, just as one might expect. Hawaii, being the "melting pot of the Pacific," flies coming from the East and from the West, along the lines of commerce, have met and mingled here, with the result that our variety of the common house-fly is not typical of either species, but rather a hybrid.

The Little House-Fly.

Fannia canicularis Linn. is another species which was recorded from Hawaii,[1] two specimens having been sent from that island to Dr. Howard in 1901. Yet no further specimens had been placed in collections here. During my recent visit to the large island (June, 1922) I found that this was the most abundant species, literally swarming in the hotel where I stopped in Waimea. Hence, it would appear that we overlook the commonest things in our collecting, by taking too much for granted.

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[1] Proc. Ent. Soc. Wash., IV, p. 490, 1901.

A List With Notes of the Insects Found on the Parker Ranch, June, 1922.

BY J. F. ILLINGWORTH.

(Presented at the meeting of November 2, 1922.)

Those marked with an asterisk (*) were not collected.

DIPTERA.

* *Psychoda* sp., abundant on manure piles.
Tipulids—several species collected on grass and under shrubbery. These were sent to Alexander for determination.
* *Culex quinquefasciata* Say, troublesome at night.
Chironomid, ex shrubbery.
Mycetophilid, abundant on cowdung.
Neoexaireta spinigera (Wied.), on shrubbery.
Sciapus pachygyna Macq., on shrubbery.
Eristalis punctulatus Macq., on flowers.
Eristalis tenax (Linn.), on flowers.
* *Xanthogramma grandicornis* (Macq.), on flowers.
Allograpta obliqua Say, on flowers.
Aphiochaeta scalaris Loew, bred abundantly from cutworm material.
Frontina archippivora Williston, abundant on cutworms.
Chaetogaedia monticola Bigot, abundant on cutworms.
Sarcophaga pallinervis Thoms., abundant on cowdung.
* *Stomorhina pleuralis* (Thoms.), ex grass.
Musca flavinervis Thoms. (?) (*domestica*), abundant in houses.
* *Stomoxys calcitrans* (Linn.), on cattle.
Haematobia irritans (Linn.), on cattle.
Lucilia sericata Wied., on shrubbery.
Chrysomyia albiceps Wied., on shrubbery.
Chrysomyia megacephala Fabr., on shrubbery.
Calliphora latifrons Hough, on shrubbery.
Hydrotaea houghi Malloch, on shrubbery.
Ophyra nigra Wied., on shrubbery.
Ophyra aenescens Wied., on shrubbery.
Fannia canicularis (Linn.), abundant in house.
Drosophila xanthosoma Grim. (?), on shrubbery.
Rhodesiella elegantula Becker, on shrubbery.
Rhodesiella tarsalis Adams, on shrubbery.
Dacus cucurbitae Coq., on shrubbery.
* *Ceratitis capitata* Wied., on peaches.
Atherigona excisa Wied. (*Acritochaeta pulvinata* Grim.), on shrubbery.
Hylemyia cilicrura Rondani (*Phorbia fusiceps* Zett.), on shrubbery.
Nine undetermined Anthomyids, etc., ex grass and shrubbery.

Orthoptera.

Pycnocelus surinamensis (Linn.), under stones.
Cutilia soror (Brunn.), under stones.
Blatella germanica (Linn.), in house.
Euborellia annulipes (Luc.), under stones.

Hemiptera.

Oechalia griseus (Burm.), ex shrubbery.
Reduviolus blackburni (White), ex shrubbery.
Reduviolus capsiformis (Germ.), ex shrubbery.
Hyalopeplus pellucidus (Stäl), ex shrubbery.
Nysius delectus White, ex shrubbery.
Nysius sp., ex shrubbery.
Siphanta acuta Walker, ex shrubbery.
Jassids, three species, ex shrubbery.
Aphis maidis Fitch, ex corn.
Psocus, two species, ex corn.

Neuroptera.

Nesomicromus vagus Perk., ex shrubbery.

Hymenoptera.

Amblyteles koebelei (Swezey), ex cutworms.
Amblyteles purpuripennis (Cresson), ex cutworms.
Echthromorpha fuscator (Fabr.), ex cutworms.
Diplazon laetatorius (Fabr.), ex shrubbery.
Chalcis obscurata Walk., ex shrubbery.
Eucoila impatiens Say, ex diptera larvae in dung.
Aphaereta muscae Ashm., ex diptera larvae in dung.
* *Sceliphron caementarium* (Drury), on shrubbery.
* *Apis mellifera* Linn., on flowers.
Pheidole megacephala Fab., ex insects.
Crabro polynesialis Cam., ex shrubbery.
Odynerus heterochromus Perk., ex shrubbery.

Lepidoptera.

Cirphis unipuncta (Haw.), ex growing corn.
Agrotis ypsilon Rott., ex growing corn.
Agrotis crinigera (Butl.), ex growing corn.
Lycophotia margaritosa (Haw.), ex growing corn.
* *Vanessa cardui* Linn., on thistle.
* *Lycaena boetica* Linn., on growing beans.
* *Anosia crippus* Cram., on milkweed.
* *Pontia rapae* (Linn.), on cabbage, nasturtiums, etc.

Coleoptera.

* *Aphodius lividus* Oliv., ex cowdung.
Gonocephalum seriatum Boisd., under stones.
Monocrepidius exsul Sharp, ex growing corn.
Philonthus longicornis Steph., ex dung.
Rhyzobius ventralis Erichs., ex shrubbery.
Coelophora inequalis (Fabr.), ex shrubbery.
* *Cryptolaemus montrouzieri* Muls., ex shrubbery.
* *Hister bimaculatus* Linn., under cowdung.
Anthicus floralis G., ex grass sweepings.
Diachus auratus (Fabr.), ex flowers.
Nitidulid, ex *Ricinus* seed.
Nitidulid, ex grass.
Pantomorus godmani (Crotch), ex growing corn.

Insects Attracted to Carrion in Hawaii.

BY J. F. ILLINGWORTH.

(Presented at the meeting of December 7, 1922.)

Recently while carrying on experiments, with dead rats as bait, I was interested in the variety of insects attracted. Naturally the first to appear were the blow-flies, *Sarcophaga barbata* Thoms., *S. dux* Thoms., *Chrysomyia megacephala* (Fabr.), *Ch. albiceps* Wied., and *Lucilia sericata* (Meigen). Other flies breeding in carrion, usually coming after decay sets in, were *Ophyra nigra* Wied., *Fannia pusio* Wied., *Synthesiomyia nudiseta* van der Wulp, and these were accompanied by a considerable variety of insects, apparently attracted by the odor of decay, as follows: *Eristalis aeneus* (Scopoli), *E. punctulatus* Macq., *Dacus cucurbitae* Coq., *Atherigona excisa* Wied., *Musca domestica* Linn., *Euxesta annonae* Fabr., *Brachydeutera argentata* (Walker), the wasp, *Pachodynerus simplicornis* Sauss., and the beetles *Clytus crinicornis* Chevr., and *Melanoxanthus melanocephalus* Thunb. Finally, when the carcass was pretty well decomposed, it was visited by the predaceous Staphylinid beetle, *Creophilus maxillosus* L., the young of which feed upon the larvae and pupae of the flies, and the skin beetles, *Dermestes vulpinus* Fabr., *D. cadaverinus* Fabr., *Attagenus plebeius* Sharp, and *Necrobia rufipes* Fabr.

I was interested to observe the predaceous habit of the larvae of *Chrysomyia albiceps*. After the carcass was almost eaten, the spiny larvae of this fly were frequently observed around the edges on the surface of the soil, with their hooks inserted into the bodies of the larger maggots of the Sarcophagids, etc. This observation led me to a little experiment. I placed fifty of these predaceous larvae in a jar of soil, with 100 larvae of the large Sarcophagid, *S. barbata*. On emergence, I found forty-eight of the *Ch. albiceps* came through in good condition—the other two dying in the puparium—while only fifty-nine of the Sarcophagids came through, three others dying in the puparium; hence, showing clearly that 38 per cent had fallen a prey to the larvae of the smaller, predaceous species. Since *Ch. albiceps* is a rather

recent introduction into these islands, from Australia, it may have an important bearing upon our other carrion feeders, especially the Diptera. It is worthy of note that *Lucilia sericata* is already noticeably scare here, while both *Ch. albiceps* and *Ch. megacephala* have become exceedingly abundant.

While in Honopu, Napali, Kauai, last June, Mr. Bryan collected a very similar fauna from a dead goat in the advance stages of decay, with the addition of the predaceous Histerid beetle, *Saprinus lugens* Erich., the other Clerid, *Necrobia ruficollis* Fabr. and some earwigs.

Halobates in Hawaii (Hemiptera).

BY E. H. BRYAN, JR.

(Presented at the meeting of May 4, 1922.)

The only insects to defy the terrors of Neptune living about Hawaii, or, with a few exceptions, to be found anywhere in the world, belong to the genus *Halobates*. These pelagic Heteroptera belong to the family Hydrometridae or water striders, and are characterized by a pubescent oval body; triangular head; four-jointed antennae; short, stout front legs; long, slender middle and hind-legs, which are inserted at the sides of the posterior end of the thorax; a very small abdomen, and an entire absence of wings.

Of the fifteen or more species of *Halobates* known, eleven are carefully described and figured in an excellent monograph by F. Buchanan White, in the Report of the Voyage of H. M. S. Challenger, Zoology, Vol. VII, pt. 19, pp. 1-82, with three plates. Using this, Dr. Illingworth and I were able to determine the identity of the specimens in the Bishop Museum collection.

Halobates wüllerstorffi Frauenfeld was brought back from Palmyra in July, 1913, as recorded by Mr. Swezey (Proc. Haw. Ent. Soc., III, p. 16, 1913). This species is common to the North and South Atlantic, Indian, and Western Pacific Oceans, but was apparently unknown previously from the East Pacific.

Halobates sericeus Eschscholtz is the common species captured at Waikiki, especially after Kona storms. It has been recorded by Osborn and Pemberton in these proceedings, Vols. III and IV. It has also been taken by Dr. C. M. Cooke, Jr., at Malaekahana, near Kahuku, Oahu, October 31, 1915; by G. P. Wilder at sea between Maui and Kahoolawe, October, 1913; and by Mr. Greenly and others at Waikiki beach, 1914 to date. F. B. White records that, next to *H. wüllerstorffi*, it is the most abundant species, but almost confined to the North Pacific Ocean. The bulk of the Challenger specimens were from stations "from Japan to Honolulu."

Dr. Sharp (Cambridge Natural History, Insects, Pt. II) states

that when the sea is calm they skip rapidly over its surface, but disappear when it becomes agitated. The whole life-cycle may be passed through far away from land. They are strong divers and shelter themselves from rough sea by keeping well below the surface. They are gregarious.

Notes on Diptera.

BY E. H. BRYAN, JR.

(Presented at the meeting of July 6, 1922.)

Trypanea.

Entomologists in Hawaii have for some time questioned the correctness of using *Tephritis* as the genus of the three species of Trypetidae, *crassipes, cratericola,* and *dubautiae,* with the large fuscous spot near the apex of the wing and the radiating fuscous bands. A short time ago I sent specimens of these three species and of *T. swezeyi* to Dr. Aldrich, for his opinion, and received the following reply: "The three species which you were in doubt about undoubtedly go in *Trypanea,* or as originally spelled and preferred by Bezzi, *Trupanea.* The amended spelling is on the authority of Hendel, which is about as good as anything could be in this family; and I prefer the corrected form, as undoubtedly the Greek 'u' should be represented in English by 'y' as in the word 'psyche.' *Tephritis swezeyi* is placed in the correct genus, as you thought. I should mention that *Trypanea* covers the same group as *Urella* in the sense of Loew's Monograph."

These species, *crassipes* (Thomson), *cratericola* Grimshaw, and *dubautiae* Bryan, are therefore to be referred to *Trypanea* Schrank (Briefe Donaumoor, p. 147, 1795). This genus is characterized by a slender body, scutellum with two bristles, and pattern of the wing, star-shaped and limited to the apex, with the rest of the wing immaculate or only spotted fuscous (in contrast to the non-radiating, reticulate pattern of *Tephritis,* covering nearly the whole wing). These two genera are well characterized and figured in Bezzi, Indian Trypaneids (fruit-flies) in the collection of the Indian Museum, Calcutta, Memoirs of the Indian Museum, Vol. III, pp. 162, 166, Pl. X, 1913.

Dolichopus exsul Aldrich.

Dr. Aldrich identified a series of Dolichopodidae, previously known as *Dolichopus* sp., which I sent him, as this species, which he recently described in Proc. U. S. Nat. Museum, Vol. 61, Art. 25, p. 15, 1922. This new species was mentioned by

Mr. Timberlake at the last meeting. Dr. Aldrich said, in a recent letter: "I was greatly interested in this species, because it was the only one known of the genus, large as it is, which occurs in a tropical climate. There are at least 350 species, and I think near 400, known in this genus now." What seems to me equally interesting is that the Oriental Collection of Mr. Muir contains a single specimen of what appears to be the same species from Tokyo, Japan, May, 1913.

Limnophora arcuata Stein.

The recently captured species of Anthomyid "hovering fly," with the four prominent black spots on the gray abdomen, reported on by Mr. Illingworth recently,* was identified by Dr. Aldrich as *Limnophora arcuata* Stein (Berlin Ent. Zeitsch., Vol. 42, p. 201), described from Georgia and Louisiana. It has since been found rather widely over the United States, in Porto Rico, St. Thomas, and Brazil. In 1920, Malloch (Trans. American Ent. Soc., Vol. 46, p. 145) made it the type of a new genus, *Eulimnophora*. Dr. Aldrich says, "The characters mentioned seem rather slight, and I have postponed changing the name of the species until I can get a more comprehensive view of the genera allied to this so as to see how many there should really be." This species is now known from Mount Olympus, Palolo Valley, Kaimuki, and Moanalua Valley, Oahu, and Kalalau, Kauai.

Pygophora lobata Stein.

A specimen of Anthomyid collected by Fullaway in Guam (No. 1259) was sent to Dr. Aldrich, and was identified by Malloch as *Pygophora lobata* Stein.

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* Reported at the April 6, 1922, meeting. See page 188 preceding.

Insects from the Summit of Mauna Kea.

BY E. H. BRYAN, JR.

(Presented at the meeting of October 5, 1922.)

Several reports have been made on the insect life at higher elevations on Mauna Loa. On September 7, 1916, William H. Meinecke exhibited specimens collected by him in Mokuaweoweo crater (Proc. Haw. Ent. Soc., III, p. 285). December 14, 1916, William A. Bryan exhibited a similar series, which he had captured on the summit the previous August (id., III, p. 295).

As long ago as 1897, Dr. H. B. Guppy, writing in the *Pacific Commercial Advertiser* on "The Summit of Mauna Loa" (see review in *Nature*, Vol. LVII, p. 21, November 4, 1897), speaks of the insect life on the summit as follows:

"Curiously enough, insects of various descriptions are common on the summit. One species of butterfly common at the coast is not at all infrequent. The butterflies were more often to be found dead than alive, and those flying about were in a half-drowsy condition and easily caught. There were flies of different kinds, the house-fly and the blue-bottle fly proving a great nuisance. Besides these there were moths, bees, gnats, and an occasional dead dragon-fly; while bugs and other insects were collected as they fed upon the bodies of dead butterflies. These insects were more common when the wind was southerly, and no doubt they had been brought up to this absolutely sterile region by the wind. Evidently most if not all of the butterflies and moths soon die, and probably the other insects, too. The whole matter is, however, very suggestive, and shows how readily insects (even the parasitic bug) may find their way into the upper air currents."

Mr. William H. Meinecke ascended to the summit of Mauna Kea, July 25, 1922, where he secured specimens of the following species: Lepidoptera: *Pontia rapae* (Linn.), the cabbage butterfly; Diptera: *Chaetogaedia monticola* Bigot, and *Frontina archippivora* Williston; Hymenoptera: *Amblyteles koebelei* (Swezey), *Echthromorpha fusco-orbitalis* Cam., *Bassus laetatorius* (Fabr.), and *Limnerium blackburni* Cam.

Concerning these he says: "Several dead cabbage butterflies were observed. Other insects, principally flies and ichneumons dead on the snow, the larger ones causing the formation of deep holes in the snow. Several flies and wasps were alive when captured." He thinks there is little doubt that all these insects were carried to the higher altitudes by the wind, and that between the lower temperature and the lower air pressure few are able to survive for any length of time.

Review of Dr. Heinrich Karny's "Der Insektenkorper und seine Terminologie."

BY E. H. BRYAN, JR.

(Presented at the meeting of October 5, 1922.)

Dr. Heinrich Karny states, in his introduction, that his object in writing "Der Insektenkorper und seine Terminologie" was to provide a simple handbook and glossary of insect morphology for persons using his tables for the determination of indigenous insects. He has done more than that.

To the student familiar with German he has given a compact, simple, little introduction to the morphology and classification of insects, such as one would find in the chapter on insects in a good text-book of Zoology. To this he has added a comprehensive glossary of 475 entomological terms, both Latin and German, with their explanations in German.

The value to the average American student of science, however, is of a different nature. Rarely do you find a young entomologist or zoologist who is also a good student of languages. And rarer still is the text-book or dictionary of a foreign language which gives the student much material help on scientific terms. That is one of the reasons for the misunderstandings between the English-speaking and foreign systematists. They either dislike or are unable correctly to translate each other's descriptions and remarks.

Dr. Karny's greater contribution, as I see it, lies in his having provided an elementary text-book of scientific German for the student studying entomology.

New Records, Identifications, and Synonymy of Diptera Found in Hawaii.

BY E. H. BRYAN, JR.

(Presented at the meeting of December 7, 1922.)

During the course of my work on Hawaiian flies, names have come to light which have been apparently omitted from local literature. Some of these determinations were made by Mr. F. W. Terry, of specimens in his collection. Some were identified for Dr. Illingworth by the late Mr. Frederick Knab, and others, recently, by Dr. Aldrich. A few of the synonyms were suggested by Major W. S. Patton, of Edinburgh.

New Records.

Calliphora latifrons Hough. [Muscidae.]

Identified by Aldrich; specimens collected by Illingworth, near Waimea, Hawaii, June, 1922.

Conicera atra (Meigen). [Phoridae.]

Identified by Knab; specimens bred by Illingworth, "ex rotten potatoes," Oahu, March, 1916.

Hydrotaea houghi Malloch. [Anthomyidae.]

Identified by Malloch; specimens collected by Illingworth, near Waimea, Hawaii, June 19, 1922; a single specimen (Swezey), Kilauea, Hawaii, February 24, 1919.

Milichia sp. [Agromyzidae.]

Det. by Knab; specimens bred "ex barley seed," by Illingworth, March, 1915.

Rhodesiella elegantula (Becker). [Chloropidae.]

Specimens collected by Illingworth, near Waimea, Hawaii, June 18, 1922. Identified by Aldrich, who says: "(*Meroscinis* of Becker, Monog. Ann. Mus. Nat. Hung., IX, 1911, p. 89.) Known from Formosa, Java. Bezzi, in Journ. N. Y. Ent. Soc., XXVII, 1919, 174, has explained that *Meroscinis* is a syn. of *Rhodesiella* Adams."

Rhodesiella tarsalis Adams. [Chloropidae.]

Specimens collected by Illingworth, near Waimea, Hawaii, June 18, 1922. Identified by Aldrich, who notes: "(*Meroscinis scutellata* de Meijere.) A widespread Oriental and African species."

Sapromyza sp. [Sapromyzidae.]

Det. by Aldrich; specimen collected by Illingworth, near Waimea, Hawaii, June 14, 1922.

Recent Identifications and Synonymy.

Aedes aegypti (Linn.) [Culicidae.]

Our common day mosquito. (= *Aedes calopus* (Meigen), *Stegomyia fasciata* (Fabr.) etc.).

Aphiochaeta scalaris (Loew). [Phoridae.]

Identification by Knab of specimens bred by Illingworth "ex dead roach," April 7, 1913. Recently identified again by Dr. Aldrich. The common, large, brownish Phorid, locally known as *"Phora* sp.," the one I bred in 1920 from dead land shells (Proc. Haw. Ent. Soc., IV, p. 489).

Atherigona excisa (Wied.). [Anthomyidae.]

(= *Acritochaeta pulvinata* Grimshaw.) Synonymy by Malloch.

Drosophila repleta Wollaston. [Drosophilidae.]

Specimens bred "ex rotten potato," March, 1916, by Illingworth, were so determined by Knab, who noted: "= *carinata* Grim." The descriptions do not agree. Also recorded by Sturtevant from Hawaii (Carnegie Pub., 301, 1921, p. 101).

Gitona perspicax (Knab). [Drosophilidae.]

Sturtevant (Carnegie Pub., 301, 1921, pp. 54, 55) says that he does not consider *Gitonides* Knab distinct from *Gitona* Meigen.

Hylemyia cilicrura Rondani. [Anthomyidae.]

(= *Phorbia fusciceps* Zett.), which was determined from Hawaii by Knab, bred ex beets, by Illingworth, 1916. Synonymy by Aldrich; specimens collected by Illingworth, near Waimea, Hawaii, June 18, 1922.

Leptocera ferruginata Stenhammar. [Borboridae.]

(= *Borborus* sp. in local collections.) Identified by Knab; specimens collected by Illingworth, Oahu, June, 1914. Very common about refuse and manure.

Milichiella lacteipennis (Loew). [Agromyzidae.]

(= *Ophthalomomyia lacteipennis* Loew.) Synonymy by Knab. The very abundant little shiny black dung-fly, with the very shiny hyaline wings.

Puliciphora sp. [Phoridae.]

The Phorid with the wingless females. Det. by Knab; specimens bred by Illingworth, "ex dead roach," January, 1916.

Synthesiomyia nudiseta van der Wulp. [Muscidae.]

(= *S. brasiliana* B. & B.; "the red-tailed Sarcophagid," etc.) Synonymy suggested by Major Patton; bred extensively ex dead rat by Illingworth. The maggots pupate together in the fur, forming a honeycomb-like mass.

The Leaf-Miners of Pipturus (Lepidoptera).

BY O. H. SWEZEY.

(Presented at the meeting of January 5, 1922.)

The mamake tree, *Pipturus albidus,* is endemic to the Hawaiian Islands. It occurs in the forests of all the large islands of the group, and is one of the trees which supports a considerable insect fauna, as shown by a paper on the subject in Proceedings Hawaiian Entomological Society, II, p. 153, 1912. At that time the leaf-miners attacking this tree were not so well known as now, but one species being mentioned, and, as it turns out now, was incorrectly determined.

Now that the leaf-miners of Pipturus have been more thoroughly studied, it is found that there are several species, some of which closely resemble one another, but occur in different localities or on different islands, illustrating the production of species by geographic isolation.

These leaf-miners all belong to the Lepidopterous family Tineidae. At present six species are recognized, and no doubt others will be found by further collecting in regions where no particular attention has been given to these insects.

Philodoria micropetala Walsm.

Fauna Hawaiiensis, I, p. 719, Pl. XXV, fig. 22, 1907.

This species was described from a single specimen collected at Halemanu, Kauai. I collected specimens of it on *Pipturus* trees at Kokee (which is near Halemanu), on August 23, 1921. The trees had mined leaves, and I consider that the mines belonged to this moth. It is found that the specimens agree with the figure and Walsingham's description of *micropetala.* That being the case, all of my previous references in Proceedings Hawaiian Entomological Society to this species occurring on Oahu as a leaf-miner in *Pipturus* are in error, as the Oahu species is not the same as these Kauai specimens. I determined specimens from *Pipturus* on Oahu by comparison with the figure of *micropetala,* and as they nearly agreed, and as there were no other near related species known at the time, I felt that prob-

ably there might be variation enough to account for the difference between my specimens and the figure.

In Proc. Haw. Ent. Soc., II, p. 222, 1913, I stated that *micropetala* (the species which was mistaken for it) occurred on all the Islands. The leaf mines that had been found in *Pipturus* up to that time, I had taken to be all of the same species of moth. Since then I have discovered several other species in different places by rearing them from the mines in the leaves.

Philodoria floscula Walsm.

Fauna Hawaiiensis, I, p. 718, Pl. XXV, fig. 21, 1907.

This species was described from Hilo and Olaa, Hawaii. I have collected it on *Pipturus* at Mountain View, Hawaii, March 31, 1906.

Philodoria pipturicola Swezey.

Proceedings Hawaiian Entomological Society, III, p. 96, 1915.

This species was reared from mined leaves collected from *Pipturus* in the forest above Punaluu, Oahu, September 13, 1914, and above Wailuku, Maui, December 9, 1922.

Philodoria pipturiella n. sp.

Antennae brownish; palpi white inwardly, externally brownish at apical portion of median and terminal joints; head and thorax grayish brown. Fore-wings bronzy brown, costal margin narrowly white to about two-thirds, where a white spot projects inward, pointing obliquely outward; sometimes the white on costa extends only half-way to this spot; a large nearly circular white spot in middle of wing at about one-third the fold which traverses its center; a large white spot at tornus, an orange spot opposite it on costa, narrowly separated from it by a metallic blue patch which widens apically; beyond the blue patch a large orange patch occupies the remaining apical portion of the wing except a small apical black spot followed by metallic blue in the apical cilia; cilia otherwise brownish, with two white spots in the costal cilia above the orange patch. Expanse of wings 5-6 mm. Hind-wings brownish as in fore-wings, cilia paler brown. Abdomen bronzy brown, whitish beneath. Legs pale brownish, whitish beneath.

Holotype in collection of Hawaiian Entomological Society. Paratypes in author's collection, and the collections of the Bishop Museum and Experiment Station of the Hawaiian Sugar Planters' Association.

Hab.—Oahu: practically the whole island wherever *Pipturus*

grows. I have reared it many times from mines in *Pipturus* leaves collected at various places in the S. E. Koolau Mountains: Palolo, Kaumuahona, Tantalus, and Pacific Heights, and also from Mount Kaala and Makaleha, in the Waianae Range. The large leaves of *Pipturus* often contain great numbers of the mines, even up to a hundred, but usually the larvae in most of them die or are parasitized so that but few of them reach their full growth and spin cocoons. The cocoons are made on the under side of the leaf alongside a prominent vein, white and not very conspicuous.

Any mention that I have previously made to *micropetala* in the Proceedings of the Hawaiian Entomological Society pertains to this species.

Philodoria pipturiana n. sp.

Antennae pale fuscous, apical portion white. Palpi whitish, streaked with fuscous externally. Head sordid whitish. Thorax dark fuscous, white beneath. Fore-wings dark fuscous to nearly black, with several white markings: a white costal bar outwardly oblique from about middle of costa extends about half-way across wing; another oblique white bar at two-thirds of costa, which recurves to the costa, terminating in a few white scales in the costal cilia; just beyond this is a curved transverse white bar nearly interrupted in the middle, its costal end terminating with a few white scales in the costal cilia (not present in the paratype); a longitudinal white streak on basal third of fold, followed by a large oval white spot about middle of fold; a large oval white spot on dorsum about at end of fold; cilia fuscous except for the white scales previously noted in costal cilia and a few white scales at base of apical cilia. Expanse of wings 8-9 mm. Hind-wings and cilia dark fuscous. Abdomen fuscous. Legs pale fuscous, tarsi white spotted.

Described from two specimens collected on *Pipturus* tree which had leaves containing leaf-miners, on the Upper Hamakua Ditch Trail, Kohala Mountains, Hawaii, July 31, 1921. In color this species resembles *nigrella* from Kilauea and forest above Hilo, Hawaii, but the white markings are distinctly different. The habits of *nigrella* are not known.

Holotype in the collection of the Hawaiian Entomological Society; paratype in collection of the Hawaiian Sugar Planters' Association.

Gracilaria neraudicola Swezey.

Proceedings Hawaiian Entomological Society, IV, p. 385, 1920.

Reared from leaf mines in *Neraudia melastomaefolia* (a tree

near related to *Pipturus*), at Punaluu, Oahu, June 11, 1916, and Waiahole, Oahu, August 13, 1916. Reared from leaf mines in *Pipturus* at Pahoa, Hawaii, September 20, 1918; in the jungle along Volcano Road south of Hilo, Hawaii, July 25, 1921; and at 2000 feet elevation on Judd Trail, Kona, Hawaii, August 14, 1919.

Correction.

My record in Proc. Haw. Ent. Soc., II, p. 222, 1913, of breeding *Philodoria basalis* Walsm. from leaf mines in *Pipturus* leaves in Kohala Mountains, Hawaii, is an error. There is a mistake about it somewhere, for since that time I have ascertained that *basalis* is the leaf-miner in *Metrosideros* or ohia lehua, on Hawaii and Maui.

TABLE OF PIPTURUS LEAF-MINERS.

1. (8) More or less orange at apex of fore-wing.
2. (7) White spot on fold usually not reaching dorsal margin.
3. (4) Apical half of fore-wing with ground color orange..*P. pipturicola*
4. (3) Much less orange at apex of fore-wing.
5. (6) White spot on fold nearly circular.....*P. pipturiella*
6. (5) White spot on fold semi-circular.....*P. micropetala*
7. (2) White spot on fold, narrow, extending to dorsal margin. *P. floscula*
8. (1) Fore-wing not orange on apical portion.
9. (10) Three outwardly oblique white spots extending inward from dorsum of fore-wing.....*G. neraudicola*
10. (9) Oval white spot on dorsum near end of fold.....*P. pipturiana*

The Erythrina Twig-Borer (Terastia meticulosalis) in Hawaii (Pyralidae, Lepidoptera).

BY O. H. SWEZEY.

(Presented at the meeting of February 2, 1922.)

Terastia meticulosalis Guené, Delt. & Pyr., p. 212, 1854.
Terastia subjectalis Led., Wien. ent. Mon., p. 480, 1863.
Megaphysa quadratalis Walker, Cat., XXXIV, p. 1527.
Megastes coeligenalis Hulst, Trans. Am. Ent. Soc., XIII, 156, 1886.
Terastia meticulosalis, Hampson, Fauna of British India, Moths, IV, p. 381, 1896.

What appears to be this Pyralid moth, I have reared from pupae found in pods of the wiliwili tree (*Erythrina monosperma*). Three of these pupae were found in pods on a tree in Makaleha Valley, Oahu, January 8, 1922. The larvae had eaten the immature seeds and pupated within a cocoon partially within the remains of the skin of the seed. There were quite a good many pods on the tree which had matured and were hanging opened with the seeds exposed. Other pods were found in which the seeds had been eaten, besides the three which contained pupae. This is the first time that the wiliwili pods or seeds have been found eaten in this way, and the first record of this moth for the Hawaiian Islands.

Hampson, in Fauna of British India, Moths, IV, 381, 1896, gives a description and figure, and the distribution as: St. Domingo; Honduras; Ceylon; Java; Philippines. He states that the "larva bores in young stems of *Erythrina*."

Fletcher, in Some South Indian Insects, p. 439, 1914, gives the distribution in South India as Bellary, Madras, and Coimbatore. He says the larva "bores into terminal shoots and unripe seed-pods of *Erythrina* of various species."

In Proceedings of the Second Entomological Meeting at Pusa, India, 1917, I find it stated that "it is sometimes a serious pest, especially of *Erythrina Indica*, the larva boring in the young shoots so that all the new growth may be killed back."

Dyar, in Journal of the New York Ent. Soc., IX, 21, 1901, describes the larva from *Erythrina herbacea* in southern Florida,

and says: "The larva is an internal feeder, boring in the younger stems which it completely hollows out, killing them. When the plant is in early flower, the young flower heads are often killed and webbed up into a foul mass by this larva. Spins a large webby cocoon in the ground."

Hulst's description of *coeligenalis* does not exactly agree with the description of *meticulosalis* given by Hampson. My specimens do not quite agree with these, nor with the figure given by Hampson. Where a species has been described under four different names, it must have some variation. Hence, I think that my specimens, the three of which show quite a bit of variation in color, come near enough to be considered this species. However, I shall endeavor to have it verified, either at the United States National Museum or by someone in India.

It seems strange that no one should have noticed the work of this moth on this side of the island, and that this first record should come from a valley so far removed from the more densely settled portions, where we should expect a new immigrant to be first noticed.

On January 29, I made considerable search for evidence of this moth on wiliwili trees on the Ewa coral plain south of Sisal. In that region there are a good many of the trees, many of them being very large. Just at this time there are many ripe pods hanging on the trees with the seeds exposed. Seach among these finally revealed the presence of remains of eaten seeds containing the cocoons of a moth. Examination of the empty chrysalids showed them to belong to the Phycitid moth *Myelois ceratoniae,* and gives us a new addition to the food plants of this moth. Six such seeds were found, but in all cases the moths had already issued. Search will be made in other localities as opportunities present.

Apparently the insect has been here a long time, but has not increased abundantly and has thus escaped notice. It no doubt arrived some time in the past, when seeds of *Erythrina Indica* or some other species were imported.

Records of Introduction of Beneficial Insects into the Hawaiian Islands.

BY O. H. SWEZEY.

(Presented at the meeting of November 2, 1922.)

Apparently the first beneficial insect purposely introduced into Hawaii was the lady beetle (*Novius cardinalis*), which is an enemy of the cottony cushion scale (*Icerya purchasi*). This was introduced from Australia in 1890 (probably via California) by Mr. Albert Koebele, who was engaged at that time in introducing beneficial insects into California to attack their orchard pests.

Since that time, there have been many species of beneficial insects successfully introduced into Hawaii, from various parts of the world, and by several institutions here. Mr. Koebele was engaged for this work in 1893. Between that time and 1904 many valuable lady beetles were introduced, also parasites of scale insects. In 1904 the Experiment Station of the Hawaiian Sugar Planters' Association began introducing parasites for the sugar-cane leafhopper, and has continued the work of introducing beneficial insects for one insect pest or another ever since. The Territorial Board of Agriculture and Forestry has also been active in this line of work; the United States Experiment Station and the Honolulu office of the United States Bureau of Entomology have also had a share in this important work.

The records of these introductions are very scattered, and in some cases very obscure, possibly entirely lacking in many cases. Herewith an attempt is made to put together for convenient reference the records of all successful introductions, so far as they could be found. They are grouped according to the various purposes for which they were introduced. The date of introduction is given, so far as known, the country from which introduced, and the particular pest on which it preys.

LADY BEETLES PREYING ON SCALE INSECTS, MEALY-BUGS, ETC.

1890. *Novius cardinalis* Muls. From Australia via California. On cottony cushion scale.

? [1] *Novius koebelei.* From Australia via California. On cottony cushion scale.

1894. *Cryptolaemus montrouzieri* Muls. From Australia via California. ? On mealy-bugs.

1894. [2] *Rhizobius ventralis* Erich. From Australia via California. On mealy-bugs.

? [1] *Cryptogonus orbiculatus* Gyll. Japan. On mealy-bugs.

1895, 1906, 1914. *Nephus* sp. near *bipunctatus* Kugel. Japan, South China, Philippines. On mealy-bugs.

1894. *Orcus chalybaeus* (Boisd.). Australia. Diaspine scales,

1894. *Serangium maculigerum* Blkb. Australia. Diaspine scales.

? *Lindorus lophanthae* Blaisd. California. Diaspine scales.

1895. *Chilocorus circumdatus* Schon. South China. Diaspine scales.

1895. *Sticholotis punctatus* Crotch. China, Japan. Diaspine scales.

1895. [3] *Pentilia nigra* Weise. China, Japan. Diaspine scales.

1908. *Azya luteipes* Muls. Mexico. Lecaniinae.

1908. *Hyperaspis jocosa* (Muls.). Mexico. *Orthezia.*

1922. *Curinus coeruleus* Muls. Mexico. *Pseudococcus nipae.*

1922. *Hyperaspis silvestrii* Weise. Mexico. *Pseudococcus nipae.*

1922. *Nephus* sp. Mexico. *Pseudococcus bromeliae.*

1922. *Diomus* sp. Mexico. Mealy-bugs.

1922. *Diomus* sp. (four-lined). Mexico. Mealy-bugs.

COCCID PARASITES.

1894. ? *Aspidiotiphagus citrinus* Craw. China, Japan. On diaspine scales.

1905. *Scutellista cyanea*. Motsch. California. *Saissetia nigra.*

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[1] Abundant in 1897, but later disappeared.

[2] The lady beetle introduced under this name, and for a long time considered as such, has recently been shown by Mr. Timberlake to be a species of *Lindorus.*

[3] Recorded as introduced, but this name is used by Koebele incorrectly, and the species supposedly introduced, although established, is as yet undetermined.

1908. [4] *Comperiella bifasciata* How. Japan. Diaspine scales.
1915. *Leptomastidea abnormis* (Gir.). Sicily via California. *Pseudococcus kraunhiae.*
1922. *Pseudaphycus utilis* Timb. Mexico. *Pseudococcus nipae.*
1922. *Coelaspidia osborni* Timb. Mexico. *Pseudococcus calceolariae.*

It is probable that many of the other parasites established in the Hawaiian Islands on introduced Coccids are some of those that were purposely introduced, but on account of their identity not being known at the time of introduction definite records are lacking.

LADY BEETLES PREYING ON PLANT LICE.

1893. [5] *Coccinella californica* Mann. California. (Disappeared after 1896.)
1894. *Coelophora inaequalis* (Fab.). Australia, Ceylon, China.
1894. *Platyomus lividigaster* Muls. Australia.
1894. *Diomus notescens* (Blkb.). Australia.
1895. *Coelophora pupillata* (Schon.). Hongkong.
Before 1894. [6] *Callineda conformis* (Boisd.). Australia. (Disappeared after 1906.)
1895. *Synonyche grandis* Thun. China, Japan. (Disappeared after 1896.)
1895. *Verania discolor* Fab. Hongkong. (Disappeared after 1896.)
1895. *Coelophora biplagiata* Swartz. Hongkong. (Disappeared after 1896.)
Scymnus, several undetermined species introduced; details of introduction not known.

OTHER ENEMIES OF PLANT LICE.

Syrphid flies and Chrysopa flies were reported established by Koebele in 1897. It is not known which species, nor where from, nor when introduced.

1904. *Chrysopa* sp. Australia.
1907. *Trioxys* sp. ? California. Parasite on orange Aphis.
1919. *Micromus vinaceus* Gerst. Queensland.

[4] Doubtfully established.
[5] Again introduced in 1905, but failed.
[6] Again introduced in 1904, but failed.

ENEMIES OF THE SUGAR-CANE LEAFHOPPER.

1904. *Paranagrus optabilis* Perkins. Queensland. Egg-parasite.
1904. *Paranagrus perforator* Perkins. Queensland. Egg-parasite.
1904. *Anagrus frequens* Perkins. Queensland. Egg-parasite.
1905. *Ootetrastichus beatus* Perkins. Fiji. Egg-parasite.
1906. *Haplogonatopus vitiensis* Perkins. Fiji. Parasite on nymph.
1907. *Pseudogonatopus hospes* Perkins. China. Parasite on adult.
1916. *Ootetrastichus formosanus* Timb. Formosa. Egg-parasite.
1920. *Cyrtorhinus mundulus* (Bredd.). Queensland and Fiji. Predacious on eggs.

BRUCHID PARASITES.

1910. *Uscana semifumipennis* Gir. Texas. Egg-parasite.
1910. *Heterospilus prosopidis* Vier. Texas. Parasite on larva.
1921. *Lariophagus texanus* Cwfd. Texas. Parasite on larva.
1921. *Urosigalphus bruchi* Cwfd. Texas. Parasite on larva.
1921. *Glyptocolastes bruchivorus* Cwfd. Texas. Parasite on larva.
1921. *Horismenus* sp. Texas. Parasite on larva.

FRUIT-FLY PARASITES.

1913. *Opius humilis* Silv. South Africa. On larva of *Ceratitis capitata.*
1913. *Diachasma tryoni* Cam. Australia. On larva of *Ceratitis capitata.*
1914. *Diachasma fullawayi* Silv. Africa. On larva of *Ceratitis capitata.*
1914. *Tetrastichus giffardianus* Silv. West Africa. On larva of *Ceratitis capitata.*
1913. *Dirhinus giffardii* Silv. West Africa. On pupa of *Ceratitis capitata.*
1913. [7] *Galesus silvestrii* Kieffer. West Africa. On pupa of *Ceratitis capitata.*
1916. *Opius fletcheri* Silv. India. On larva of *Bactrocera cucurbitae.*

[7] Doubtfully established.

OTHER ENEMIES OF DIPTERA.

1906. *Eucoila impatiens* Say. Arizona. On larva of *Sarcophaga*.
1909. [7] *Bathymetis* sp. Germany. On puparium of horn-fly.
1909. *Hister bimaculatus* L. Germany. Predacious on maggots.
1913. *Muscidifurax raptor* Gir. & Sand. South Africa. Parasite on puparia.
1914. *Pachycrepoideus dubius* Ashm. Philippines. Parasite on puparia.
1914. *Spalangia philippinensis* Ful. Philippines. Parasite on puparia.
1914. *Spalangia* sp. Africa. Parasite on puparia.
1921. *Creophilus erythrocephalus* Fab. Australia. Predacious on maggots.

PARASITES OF LEAF-ROLLERS AND ARMY WORMS.

1895. *Microbracon omiodivorum* (Terry). Japan. On larva of leaf-rollers.
1895. *Chalcis obscurata* Walker. Japan. On pupa of leaf-rollers, etc.
? *Amblyteles koebelei* (Sw.). California. Army-worm parasite.
? *Amblyteles purpuripennis* (Cress.). California. Army-worm parasite.
? *Frontina archippivora* Will. North America. Army-worm parasite.

MISCELLANEOUS.

1904. *Aphanomerus pusillus* Perk. Queensland. Egg-parasite of *Siphanta acuta*.
1909. *Blastophaga psenes* (Linn.). California. Caprifier of edible fig.
1910. *Ceromasia sphenophori* Vill. New Guinea. Parasite of larva of *Rhabdocnemis obscura*.
1916. *Paranagrus osborni* Ful. Philippines. Egg-parasite of corn leafhopper.
1916. *Scolia manilae* Ashm. Philippines. Parasite of larva of *Anomala* and *Adoretus*.

[7] Doubtfully established.

1917. *Dolichurus stantoni* Ashm. Philippines. Parasite on nymph of roach.
1921. *Ischiogonus syagrii* Ful. Australia. Parasite of larva of Australian fern weevil.
1921. *Pleistodontes froggatti* Mayr. Australia. Caprifier of *Ficus macrophylla.*
1922. *Pleistodontes imperialis* Saund. Australia. Caprifier of *Ficus rubiginosa.*
1922. *Notogonidea luzonensis* Rohwer. Philippines. Parasite of field cricket.
? *Stethorus vagans* Blackburn. Predacious on leaf-mites.

LANTANA INSECTS.

1902. *Agromyza lantanae* Frogg. Mexico. Larvae in seeds.
1902. *Thecla echion* Linn. Mexico. Larvae on flowers.
1902. *Thecla agra* Hew. Mexico. Larvae on flowers.
1902. *Crocidosema lantana* Busck. Mexico. Larvae in flower clusters.
1902. *Platyptilia pusillidactyla* Walk. Mexico. Larvae in flower clusters.
1902. *Cremastobombycia lantanella* Busck. Mexico. Leaf-miner.
1902. *Teleonemia lantanae* Distant. Mexico. Leaf-bug.
1902. *Eutreta xanthochaeta* Aldrich. Mexico. Stem gall-fly.

ANNUAL ADDRESS.

Notes on the Mealy-Bugs of Economic Importance in Hawaii.

BY DAVID T. FULLAWAY.

(Presented at the meeting of December 7, 1922.)

These notes have resulted from a study of our common dactylopiine species [1] made preparatory to handling the material collected by H. T. Osborn in Mexico, which, during the past few months, has been chiefly mealy-bug enemies. Mr. Osborn's investigations in this field began primarily with the definite purpose of introducing and acclimatizing the coccinellid beetle *Hyperaspis silvestrii*, observed by Koebele and Silvestri to be an important enemy of *Pseudococcus nipae* in Mexico. The pursuit of this object led him gradually to widen the scope of his work, with the result that we have received from him numerous and sizable shipments of four species of coccinellid beetles, in addition to *Hyperaspis silvestrii*, and five or six internal parasites of mealy-bug species existing here. While the extent of Mr. Osborn's achievement in Mexico could scarcely be anticipated, the results amply justify a belief which I have held for some years; namely, that, in view of the comparative scarcity of some of the species existing here which are attacked by internal parasites, it should be possible to ameliorate present conditions with regard to other species unchecked by internal parasites, by seeking out such enemies as exist and introducing them here. I believe all of the economically important mealy-bug species found here have been brought to the islands in the course of time with plants. In some cases, one or other of their enemies have been brought with them, or have since been purposely introduced. Undoubtedly the present situation with regard to mealy-bug infestations represents a great improvement over the

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[1] According to list following. *Eriococcus araucariae* and species of *Asterolecanium* omitted from consideration, as *Eriococcus* and allies and *Asterolecanium* and allies are now viewed as separate subfamilies. The affinities of *Phyllococcus* also being in question, that genus has not been included in the present discussion either.

conditions prevailing, say twenty or twenty-five years ago, and much of this improvement is due to the excellent work done by the numerous species of coccinellid beetles introduced by Koebele from the Orient and Australia. But with regard to most of the species, and particularly those infesting crop plants, the present situation is far from being satisfactory, and a remedy should be sought in the way I have indicated. Mr. Osborn's work in Mexico furnishes an example of what can be done.

In carrying out an idea of this sort, a primary concern is to learn the center of distribution of the noxious species, and to that end all the data bearing on this point should be collected and carefully considered. Unfortunately, in some cases, the available data is valueless for the purpose mentioned. In that contingency, the only recourse is to investigate one zoological region after another until a fruitful one is found. In other cases, however, the way is clearly marked.

The point is here made that conversely to the proposition above stated, the presence of several or numerous parasites of a noxious species in any definite region is *prima facie* evidence on the origin or center of distribution of the species. Such evidence is now available for three of our species, and Mr. Timberlake has pointed out the weight of evidence with regard to two others.

Another important consideration in an undertaking of this kind is ability to recognize any particular species in hand. The main purpose of my study was to familiarize myself with the different species, so that the material sent in could be handled with safety and utilized to the greatest advantage. After gaining a thorough knowledge of the species, it was easy to formulate the keys here given to the subfamily, genera, and species under consideration, which may be useful to others working on this group of insects. Thanks to the careful and painstaking work of Ferris, Morrison, and others, who have pointed out the greater dependability of morphological characters, the distinction of mealy-bug species now rests upon much surer ground than formerly. With regard to the keys just mentioned, I will say that I have tried, in the case of species, to combine morphological characters in a table with the more obvious distinguishing marks or traits. I have also sought to indicate my views as

to the relationships of the different genera and species. And where I could facilitate access to species in nature or in the literature by giving data or references I have done so. A few drawings are furnished to illustrate obscure points in the descriptions.

According to the latest classifications of the Coccidae, the subfamilies Monophlebinae, Ortheziinae, Eriococcinae, Dactylopiinae, Asterolecaniinae, Coccinae, and Diaspinae include all the Hawaiian species, and the following key will indicate the distinction of the species under consideration.

KEY TO SUBFAMILIES.

1. Body covered by a firm waxy scale separable from the insect and made up in part of larval exuviae; legs lacking; posterior end of the abdomen pygidiform ..... *Diaspinae*
   Not so 2
2. With two or more pairs of abdominal spiracles, anal ring placed dorsally some distance before the body apex and not at the end of a cleft 3
   Without abdominal spiracles, anal ring placed at or close to the body apex, or if dorsally, at the anterior end of a cleft in the body... 4
3. With not more than two pairs of abdominal spiracles, anal ring without setae ..... *Monophlebinae*
   With seven pairs of abdominal spiracles, anal ring with setae. *Ortheziinae*
4. Body usually with the posterior extremity cleft, anal opening at the anterior end of this cleft and covered by a pair of triangular plates; these characters more or less obscured in the species that are covered with wax..... *Coccinae*
   Posterior extremity of body not cleft, sometimes more or less indented, but never with plates over anal opening..... 5
5. Body margin with a row of eight-shaped gland pores; legs wanting; antennae very much reduced, minute..... *Asterolecaniinae*
   Not so 6
6. Dorsal ostioles present..... *Dactylopiinae*
   Dorsal ostioles absent..... *Eriococcinae*

The group Dactylopiinae as delimited for the purposes of this paper comprises the following species, listed under their respective genera according to the author's conception of their affiliation. The synonymy is also indicated.

Genus Antonina Signoret.

bambusae (Mask.).

vide Morrison, Pr. U. S. N. M., 60, p. 55 (1922); Green, Coccidae of Ceylon, Pt. V (1922).

Sphaerococcus bambusae Mask. N. Z. Trans., XXV, p. 237 (1892).

Chaetococcus bambusae (Mask.) Ckll. Rev. Mus. Paul., III, p. 501 (1898).

Kermicus bambusae (Mask.) Ckll. Entomologist, XXXII, p. 93 (1899).

crawi Ckll.

Psyche IX, p. 71 (1900); Kuwana, Pr. Cal. Ac. Sci. 3, III, p. 57 (1902); Ehrhorn Pr. H. E. S., III, p. 236.

indica Green.

Mem. Dep. Ag. India, II, 2, p. 27 (1908) Fig.

Antonina boutelouae auct. *vide* Ehrhorn, Pr. H. E. S., III, p. 282.

Genus Geococcus Green.

radicum Green.

Ent. Mo. Mag., XXXVIII, p. 262 (1902).

Ripersiella rhizophilla Fullaway & Kotinsky (*sine* descr.) Ent. News, XXI, p. 49 (1910); Fullaway, Pr. H. E. S., II, p. 108.

Genus Ferrisia *Novum.*

virgata (Ckll.).

Dactylopius virgatus Ckll. Entomologist, XXVI, p. 178 (1893).

Pseudococcus virgatus (Ckll.). Kirkaldy, F. H., III (2), p. 103 (1902).

Genus Trionymus Berg.

sacchari (Ckll.).

Dactylopius sacchari Ckll. Jn. Trin. Nat. Club, II, p. 195 (1895).

Pseudococcus sacchari (Ckll.). Ehrhorn Pr. H. E. S., III, p. 1 (1913).

Pseudococcus calceolariae auct. Ehrhorn loc. cit.

calceolariae (Mask.).

Dactylopius calceolariae Mask. N. Z. Trans. XI, p. 218 (1878).

Pseudococcus calceolariae (Mask.). Kirkaldy F. H., III (2), p. 103.

Pseudococcus sacchari auct. *vide* Ehrhorn loc. cit.

Pseudococcus saccharifolii auct. Ferris in litt.

lounsburyi (Brain).

Pseudococcus lounsburyi Brain An. Ent. Soc. Am., V, p. 179 (1912), Figs.

insularis Ehrhorn.

Pr. H. E. S., III, p. 244 (1915).

Genus Pseudococcus Westwood.

nipæ (Mask.).

Dactylopius nipae Mask. Tr. & Pr., N. Z. Inst., 1892, XXV, p. 232 (1893), Figs.

filamentosus (Ckll.).

Dactylopius filamentosus Ckll. Entomologist, XXVI, p. 268 (1893).
Pseudococcus vastator (Mask.) Kirkaldy F. H., III (2), p. 103 (1902).

kraunhiae (Kuwana).

Dactylopius kraunhiae Kuw. Pr. Cal. Ac. Sci. (3), III, p. 55 (1902), Figs.
Pseudococcus citri auct.

longispinus (Targ.).

Dactylopius longispinus Targ. Cat., p. 32 (1869).
Pseudococcus adonidum (Linn.). Kirkaldy F. H., III (2), p. 103 (1902).

brevipes (Ckll.).

Dactylopius brevipes Ckll. Entomologist, XXVI, p. 267 (1893).
Pseudococcus bromeliae auct. *vide* Science n. s., LV, 1422, March 31, 1922, and LVI, 1446, September 15, 1922.

Genus Tylococcus Newst.

giffardi Ehrhorn.

Pr. H. E. S., III, p. 243 (1915).

Genus Ripersia Sign.

palmarum Ehrhorn.

Pr. H. E. S., III, p. 245 (1915).

KEY TO GENERA.

1. Abdomen of the adult female posteriorly invaginated, the anal ring at the inner end of this invagination.....*Antonina*
   Not so 2
2. Anal lobes very prominent, chitinous, with a stout sabertooth-like spine at extremity of each lobe and two pairs of chitinous hooks on the dorsum, one pair on the head and the other immediately cephalad of the anal ring.....*Geococcus*
   Not so 3
3. Anal cerarii with two cerarian spines..... 4
   Anal cerarii with more than two cerarian spines..... 6
4. With tubular wax pores in clusters about margins of segments, particularly at caudal end.....*Ferrisia* n. g.
   Not so 5

5. With circular wax pores numerous and closely crowded in derm of caudal segments, numerous dorsal setae, few pairs of cerarii and these on the distal segment or segments of abdomen, body usually elongate ..... *Trionymus*

With circular wax pores less numerous and closely crowded in derm of caudal segments, fewer dorsal setae, many pairs of cerarii, usually seventeen to nineteen, distributed on the abdominal, thoracic, and cephalic segments, body usually of oval form. *Pseudococcus*

6. Antennae eight-segmented, body with marginal tumescences. *Tylococcus*

Antennae six-segmented, body without marginal tumescences *Ripersia*

Genus Antonina Signoret.

Pseudococcine forms without legs in the adult female; with the antennae in the adult female reduced to mere stubs; without recognizable cerarii; with the posterior end of the body more or less invaginated, this invagination forming a tube at the inner end of which is the anal ring. Spiracles very large and conspicuous. Circular, multilocular pores present on the dorsum.

Type of the genus *Antonina purpurea* Sign.

Three species of this genus are commonly found in Hawaii, two on bamboos grown for ornamental purposes, and one on the common lawn and pasture grass *Cynodon dactylon*. They are of no great significance economically.

The species may be distinguished by use of the following key:

1. Entire derm heavily chitinized; large; 8 mm. long..... *bambusae*

Less heavily chitinized, the derm thick only on posterior abdominal segments; smaller 2

2. Abdominal spines fairly stout; body oval (on bamboo)..... *crawi*

Abdominal spines very slender; body rotund (on Bermuda grass).. *indica*

Morrison (Pr. U. S. N. M., 60, p. 56) describes and figures *bambusae*, and it is on the basis of his comparisons (p. 58) that the species is included in *Antonina*. Green gives excellent figures of *indica* and *bambusae* and describes the latter in considerable detail in Part V of the Coccidae of Ceylon.

Genus Geococcus Green.

Pseudococcine form with the antennae set very close together at the front of the head; six-segmented, the terminal segment

large; legs present. Body terminating in a pair of prominent anal lobes with a stout sabertooth-like spine at the extremity of each lobe. Derm with trilocular pores. Anal ring setiferous.

Type of the genus *Geococcus radicum* Green.

A monotypical genus described from Ceylon and, according to Green (loc. cit.), not known elsewhere except in Hawaii. Mr. Ehrhorn, however, has called my attention to the similarity of Kuwana's *Ripersia oryzae* (Bul. Imp. Cent. Ag. Exp. Sta., 1, p. 186, 1907), described from Japanese material collected on the roots of rice and other plants, and in Ent. Mo. Mag., LIX, p. 18, January, 1923, the species is said to occur in the West Indies. The species is fairly common in Hawaii, in a more or less complete pulverulent white waxy sac on the roots of plants (koa, mango, nut-grass, etc.), but of no great significance economically. A good figure and description of the insect is furnished in a paper by the author published in Proc. Haw. Ent. Soc., II, p. 108. Green, in his recently published Pt. V of the Coccidae of Ceylon, also gives excellent figures and redescribes the insect in much detail. No mention, however, has heretofore been made of the chitinized strip of the derm at the margin of the penultimate segment extending inward obliquely and bearing two prominent setae. It is quite plain in stained specimens. Green's figures also fail to show the accessory spines in the adult, although present in the nymph. It is possible that the Hawaiian forms so far observed have all been immature.

Genus Ferrisia *Novum.*

Characterized for the reception of the species hitherto passing under the name of *Pseudococcus virgatus.* A pseudococcine form without a tooth or denticle on the face of the tarsal claw and with eight-segmented antennae, but differing from typical species of *Pseudococcus* by having only a single pair of cerarii, situated on the anal lobes, and by the possession of numerous peculiar wax ducts, which are unusually large and have their mouths surrounded by a small chitinized area bearing one to four small setae.

Type of the genus *Pseudococcus virgatus* (Ckll.).

This is a tropical species with a wide distribution. The facts with regard to this so far elicited have warranted Timberlake's

stating that it points to Oriental origin. The species is treated by Ferris in an article on Mealy-Bugs in Jn. Econ. Ent., XII, p. 297, where the fact in regard to its aberrancy is plainly stated. Ferris describes the morphological characteristics and figures the important distinguishing characters. Morrison in his paper on the Philippine Non-diaspine Coccidae (Phil. Jn. Sci., 17, 2, 1920) and Green in his Coccidae of Ceylon, Pt. V, also figure the essential characters of this species. The latter author gives a rather poor illustration of the insect as it appears in nature.

Genus Trionymus Berg.

Pseudococcine forms with circular wax pores numerous and closely crowded, particularly in the derm of caudal segments; with numerous dorsal setae and few cerarii. Tarsal claw without a denticle and antennae of adult female seven or eight-segmented.

Type of the genus *Trionymus perrisii* (Sign.).

Four species referable to this genus are commonly found in Hawaii, two on sugar-cane, the other two on lilies and Bermuda grass respectively. The species commonly known as the Pink Mealy-Bug, formerly referred to as *Pseudococcus calceolariae* and now believed to be Cockerell's *P. sacchari,* is always present behind the leaf-sheath on sugar-cane, and usually the infestation is extensive. It is a pest of considerable economic importance. The legs, antennae, and certain morphological characters have been figured by Morrison (Phil. Jn. Sci., 17, 2, 1920). The species, formerly misidentified as *P. sacchari* and *P. saccharifolii* but now believed to be Maskell's *calceolariae,* has not heretofore been fully characterized or figured. A brief diagnosis follows, illustrated by drawings:

Trionymus calceolariae (Maskell).

In life.—Concealed beneath the sheathing bases of the leaves of its host, surrounded by masses of wax. It appears slenderer and less rotund than either of the other two species of mealy-bugs occurring in the same situation, and the body color is grayish rather than pinkish, as in those species. The filaments of wax from the penultimate and anal lobes are heavy; and there are also four or five finer filaments cephalad of these on either side. The dorsal covering is mealy and rather light. Oviparous, the ovisac loose and fluffy. Color when heated in KOH lilac, a rose tint being meanwhile

imparted to the liquid. The species is less prevalent than either of the other two, presumably on account of an extensive parasitism.

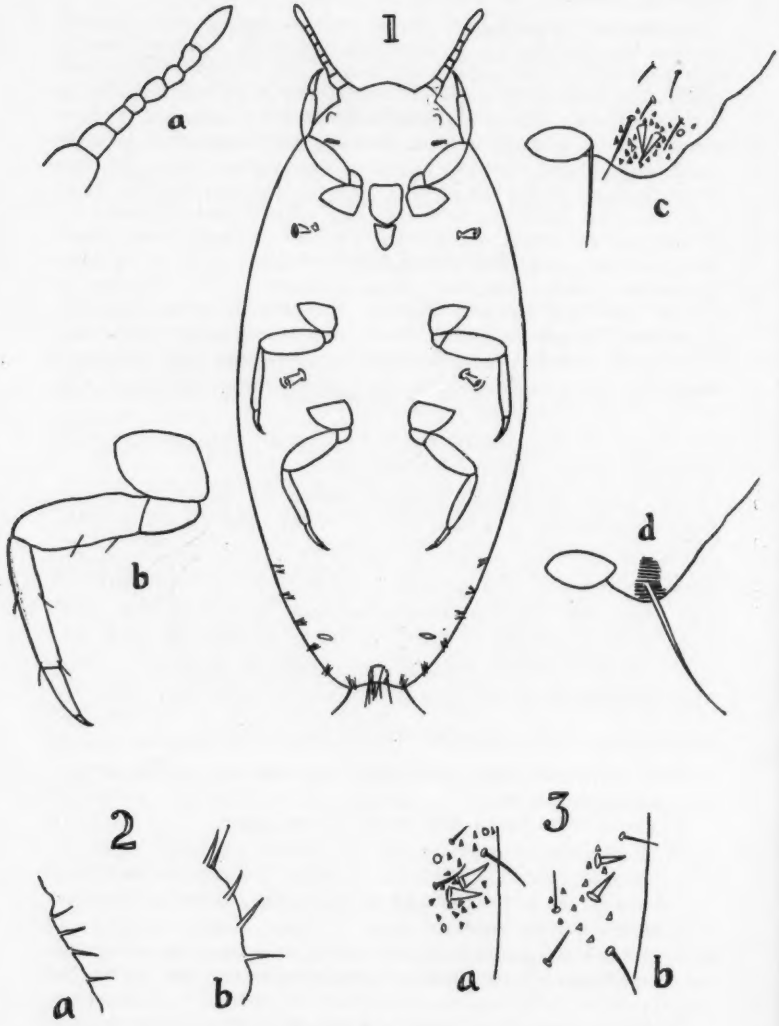
Morphological characteristics.—About twice as long as wide, legs and antennae well developed; i. e., fairly long and thick. Antennae seven or eight segmented, apical segment the longest, one and two stout, second next to apical segment in length and considerably longer than first, though scarcely more than half as wide; third shorter and narrower; fifth, sixth, and seventh (or fifth and sixth in seven-segmented specimens) subequal, fourth smaller. Anal lobes and anal ring fairly well developed. Six pairs of cerarii at the caudal end of body, only the anal lobe pair well developed, the others decreasing in size as they progress toward anterior end of body, and all without chitinizations, but with triangular pores grouped about them fairly closely and accompanied by auxiliary setae. A triangular chitinization (weakly developed in some specimens) on the ventral side of the anal lobe. Anal lobe setae long and fairly stout, somewhat longer and stouter than the anal ring setae. Derm with many triangular pores, small tubular ducts without raised rim about the mouth, and large numbers of multilocular pores, particularly at caudal end of body. Dorsal body setae fairly numerous, particularly so on the head.

Authentication. Authenticated by Ferris, who has examined specimens sent to Green by Maskell himself.

The species heretofore passing under the name of *Pseudococcus lounsburyi* is a pest on lily bulbs, and affects to some extent the growing plants. It would be of considerable importance economically if lilies were more extensively cultivated here than they are. Brain's description and figures of the insect (loc. cit.) are ample. I have, however, figured the anal lobe cerarii of this and the grass-infesting species, *insularis,* to illustrate morphological distinctions referred to in the following key.

KEY TO SPECIES OF TRIONYMUS.

1. Form short oval, width, considerably more than half the length (on sugar-cane and rice) ..... *sacchari*
   Slenderer, width hardly more than half the length 2
2. With six pairs of cerarii on the six posterior abdominal segments (on sugar-cane) ..... *calceolariae*
   With only one or two pairs of cerarii on the ultimate or ultimate and penultimate segments 3
3. With two pairs of cerarii and numerous wax pores (about twenty-five) closely grouped around cerarian spines on anal lobe (on lilies). *lounsburyi*
   With only one pair of cerarii, the anal lobe pair, wax pores around the cerarian spines fewer, not more than twelve, and less closely placed (on Bermuda grass) ..... *insularis*



Trionymus calceolariae.

Genus Pseudococcus Westwood.

Pseudococcine forms with triangular wax pores in the derm predominating over those of the circular type; with many cerarii, usually seventeen to nineteen pairs, distributed among the abdominal, thoracic, and cephalic segments. Tarsal claw without a denticle and antennae of adult female seven or eight segmented.

Type of the genus *Pseudococcus longispinus* (Targ.).

As limited above, the genus comprises but five species in Hawaii, all of which are agricultural or horticultural pests of considerable economic importance and are consequently treated *in extenso*.

The species may be distinguished by use of the following key:

1. Derm with dorsal rows of spines, besides the marginal cerarian spines, the latter toward the middle of the body tending to become widely separated 2

   Derm without dorsal rows of spines..... 3

2. Cerarian spines short and stout, the three pairs of the marginal series in front of the anal lobe pair widely separated.

   Usually occurring individually; ovoviviparous, therefore never developing an ovisac; dorsal secretion in rows of small granular masses, lateral filaments subequal, cylindrical; derm dark red, becoming purple madder when boiled in KOH; wide range of host plants, but commonly found on guava, avocado, palms, Ficus carica, Ficus bengalensis, Sterculia urens, Asparagus spp., mulberry .....*nipae*

   Cerarian spines longer and more slender, the pairs immediately in front of the anal lobe pair close together.

   Usually occurring in clusters, under cover of densely matted yellowish white wax; the species is oviparous and this covering is the ovisac; eggs purplish; integument shining black, becoming violet carmine when boiled in KOH; secretion heavy,

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Fig. 1. *Trionymus calceolariae* (Mask.) a, antennae; b, leg; c, anal lobe showing cerarii, triangular pores, and auxiliary setae; d, anal lobe, ventral side, showing triangular chitinization.

Fig. 2. *Antonina spp.* abdominal spines; a, *indica;* b, *crawi.*

Fig. 3. *Trionymus spp.* Anal lobe cerarii, triangular wax pores, and auxiliary setae; a, *lounsburyi;* b, *insularis.*

lateral filaments so wide they appear coextensive around margin of body, which is elevated from its base by cushion of waxy filaments, dorsal secretion appearing as four heavy double knob-like masses on each side and some finer filaments extending laterally behind these. Wide range of host plants, but commonly found on citrus, leguminous plants, cotton, hibiscus, Clerodendron squamatum ..... *filamentosus*

3. Cerarii without auxiliary setae, except in the last two abdominal pairs; eighteen pairs of cerarii, each with two spines, filiform at apex, those of the anal lobe cerarii longest, with scattered pores and two or three auxiliary setae, ventral surface of anal lobe with a prominent narrow chitinized streak extending inward obliquely from the base of the large seta, the latter about a third to a half longer than the anal ring setae.

   In life dull brownish yellow, dorsal secretion of wax light, giving body a grayish tinge, a dark median longitudinal streak often apparent; color when boiled in KOH carmine; marginal filaments short and approximately equal in length, those from anal lobe a little longer; oviparous, egg sac formed posteriorly and somewhat spherical in shape, eggs yellow. Wide range of host plants, but commonly found on mango, crotons, pomegranate, Ficus bengalensis (aerial roots), Calathea... *kraunhiae*

Cerarii with auxiliary setae..... 4

4. Anal lobe and penultimate cerarii strongly chitinized, seventeen pairs of cerarii, the first three or four pairs with three or four conical spines, the remainder with two, these increasing in size gradually toward posterior end of body, penultimate pair and anal lobe pair much larger, the latter being extremely stout, all accompanied with numerous pores which are concentrated into a crowded circular area about spines in the case of anal lobe and penultimate cerarii. Ventral side of anal lobes with a large triangular chitinized area, apex directed forward, a narrow thickening along median edge. Anal lobe setae shorter and more slender than anal ring setae.

   In life dull yellowish brown, form long oval, dorsal secretion of wax light with some short filaments, giving body a farinose to grayish tinge; marginal filaments unusually long, lateral filaments half body width, those from anal lobes as long as body, penultimate pair stouter and only half as long; body elevated from its base by cushion of waxy filaments, but ovoviviparous, therefore no egg sac formed; color when boiled in KOH becoming purple lake. Wide range of host plants and particularly in glass-houses on maiden-hair fern, ornamental species of Asparagus, etc..... *longispinus*

Anal lobe cerarii weakly chitinized at most, penultimate pair not chitinized, seventeen pairs of cerarii, all with numerous pores, first

three, the penultimate and the three or four pairs anterior to the penultimate pair usually with three or four spines, those of the anal lobe the largest, no chitinized areas about any of the cerarii, although chitinization is faintly indicated about anal lobe cerarii. Ventral side of anal lobes with quite large chitinized area extending in from the base of the anal lobe setae; anal lobe and anal ring setae nearly equal, one and one-half times diameter anal ring.

In life salmon pink, form oval to short oval, fairly convex, dorsal secretion of wax fairly abundant, hiding the color of the derm; marginal filaments not very long (less than one-fourth width of body) and more or less uniform in length excepting the filaments from the anal lobes and those immediately anterior to them, which grade posteriorly from the length above stated to nearly the full length of the body in the case of those of the anal lobes. Beneath this pair are two short plate-like filaments and some fluffy wax, occasionally a drop of honey-dew. The species is negatively phototropic. It is ovoviviparous, therefore no egg sac is produced. Always present on pineapples, sugar-cane, and bananas, and often found on other plants, particularly on sisal, soursop, and on the roots of cannas, nut-grass, etc.....*brevipes*

Pseudococcus brevipes (Cockerell).

I have accepted Professor Cockerell's suggestion to use the above name for the common species on pineapples, bananas, etc., which has apparently now become widely distributed with the transference of plants from one region to another in the interest of agricultural development. Secretive in habit, it could be overlooked without fault of anyone on plants in transit from one country to another, and this habit has probably aided its dissemination.

The species appears to be partial to bromeliaceous and allied plants, and, in view of the discovery of several internal parasites of it in Central and South America, I consider it indigenous in the tropical portion of the American continent. It does not seem to flourish outside the tropics.

The species (under the name *bromeliae*) is treated by Ferris in a paper entitled "Observations on Some Mealy-Bugs" in Jn. Econ. Ent., XII, p. 296, and a figure given of the distinguishing morphological characters. Ferris established the identity of our species by including it with specimens from Florida and the West Indies, which Cockerell has stated are identical with *brevipes*. Morrison (loc. cit.) and Green (Pt. V, Coccidae

of Ceylon) also figure the morphological characteristics of the species (under the name *bromeliae*).

Ehrhorn considers that Kuwana's *ananassae* is probably the same species.

Pseudococcus nipae (Mask.).

This is another species believed to belong to the tropics of the American continent, although now widely spread through the transference of ornamental plants from one region to another. The belief just mentioned is based on the presence of numerous enemies of this species in Mexico, some of which appear to be rather strict. As already stated, the species is a serious agricultural and horticultural pest, and the Hawaiian Government has recently introduced three species of coccinellid beetles and three internal parasites (two encyrtids and one scelionid) to secure a measure of relief from its attacks on fruit trees and ornamental plants.

The species is treated by Ferris in a publication on "The California Species of Mealy-Bugs" in the Stanford University series, p. 49, and a figure given of the penultimate and anal lobe cerarii and the ventral side of the anal lobe showing the peculiar character of the chitinization and grouping of pores.

Pseudococcus filamentosus (Cockerell).

This is another tropical species now widely distributed, probably on citrus stocks or scions, as it affects citrus very generally and has proved a great hindrance to citrus culture in Hawaii, causing malformation of the terminal growth. According to Koebele it gained entrance to Hawaii about 1891, from Japan. It also affects leguminous plants generally, and in Cairo, Egypt, caused serious injury to leguminous shade-trees in 1909. At that time it was the subject of much study and investigation, which was afterward reported upon in a paper by F. C. Willcocks, entomologist to the Khedevial Agricultural Society, published in the Bull. Ent. Res., I, p. 121. The species was considered as new and was so described by Newstead and Willcocks under the name *Dactylopius perniciosus,* but Kränzlin, in 1913, in describing a similar infestation at Dar-es-Salaam (see Rev. Appl. Ent., II, p. 146), refers the Egyptian and the Tanganyika insect, rightly I believe, to *filamentosus.*

Newstead and Willcocks (loc. cit.), Robinson (Phil. Jn. Sci., XII D, p. 8), and Ferris (Coccidae of Lower California, Stanford U. Pubs. Biol. Ser., I, 2, p. 83) have all described or figured structural details of this species. The account of the first-mentioned authors is particularly full and complete. In this account the authors make the statement: "Small parasitic Hymenoptera belonging to the family Chalcididae appear to play a very important role in the natural control of this pest. Three members of this family have been reared from the mealy-bug." This parasitism of the species in Africa by Chalcids has been confirmed by E. W. Rust, field entomologist of the California State Department of Agriculture, who reared parasites from it in South Africa. The presence of parasites of this species on the African continent and their absence elsewhere leads me to believe that the species is indigenous to that continent. The introduction of these parasites at Hawaii would be a valuable service, and if their establishment could be secured, they would undoubtedly help materially in the control of *P. filamentosus*, which now rests entirely on the work of the polyphagous predators, *Cryptolaemus montrouzieri, Scymnus bipunctatus,* and *Gitonides perspicax*.

Morrison (loc. cit.) also figures the leg, antennae, and certain morphological features of this species, and the present author in Bul. 18, Hawaii Experiment Station, illustrates its appearance in nature.

Pseudococcus kraunhiae Kuwana.

The distinction between *Pseudococcus kraunhiae* and *Pseudococcus citri* is made on the basis of very slight differences. Ferris, however, believes the species can be discriminated in California, and the morphological characteristics of the Hawaiian form, as judged by his standards, point to its identity with the former species rather than the latter. Timberlake brings additional evidence to bear on the question by claiming a biological dissimilarity between the Hawaiian mealy-bug and what passes for *citri* in California. He says: "Whatever species ours is, it it constantly parasitized by the encyrtid *Pauridia peregrina,* while the species in California which goes under the name of *citri* is apparently not receptive to this parasite." Possibly both species are present in Hawaii as well, but this contingency has

never been satisfactorily demonstrated. If, as held by some, *kraunhiae* and *citri* are synonymous, the Hawaiian insect represents a very widely spread and polyphagous species. On the other hand, the distribution of typical *kraunhiae* is very limited, it being confined to Japan and California outside of Hawaii. Once it was recorded from quarantined plants in New Jersey, but the record lacks confirmation. The Hawaiian insect is heavily parasitized by *Leptomastidea abnormis* as well as by *Pauridia peregrina* and is the prey also of other polyphagous mealy-bug enemies. It is, therefore, of much less significance as an agricultural and horticultural pest than some of the other mentioned species, although occasionally a heavy infestation will be observed.

Ferris has described the morphological characteristics of both species in his paper on "The California Species of Mealy-Bugs" (loc. cit.), and figures the distinguishing characters. A good illustration of *P. citri* as it appears in nature, which might well pass for *P. kraunhiae* also, is found in connection with Sanders' paper on "The Identity and Synonymy of Some of Our Soft Scale Insects" in Jn. Econ. Ent., II, p. 428.

Pseudococcus longispinus (Targ.).

This is another tropical or subtropical species of wide distribution and with a wide range of host plants. It is particularly a greenhouse pest, flourishing most luxuriantly in a warm, still, moist atmosphere. Ferris treats this species in his paper on "The California Species of Mealy-Bugs" (loc. cit.), describing the morphological characteristics and giving figures of the important characters. Sanders, in a paper on "The Identity and Synonymy of Some of Our Soft-Scale Insects" (loc. cit.), gives an excellent illustration of this mealy-bug as seen in nature. Green also describes and figures the species in Pt. V of the Coccidae of Ceylon.

Genus Tylococcus Newst.

Pseudococcine forms without a tooth or denticle on the face of the tarsal claw and with eight-segmented antennae, well developed anal ring bearing six long stout setae, and marginal tumescences corresponding to the cerarii, each of which consists of a triangular or scutiform chitinization beset with a

number of stout spines, auxiliary setae, and triangular wax pores, the caudal pair the largest and provided each with a very long seta. Derm with numerous triangular pores, a few circular pores, and setae in rows and patches.

Type of the genus *Tylococcus madagascariensis* Newst.

Only one species referable to this genus is found in Hawaii, viz., *T. giffardi* Ehrhorn. It infests species of *Pandanus,* but without very serious consequences. The species is included because *Pandanus odoratissimus,* which grows wild in Hawaii, is the source of the lahala woven fabrics. Several other forms are cultivated as ornamental plants. The type species is illustrated by Newstead in the original publication, but the figure showing the outline of the body is believed to exaggerate the degree of marginal tumescence.

Genus Ripersa Sign.

Pseudococcine forms with six-segmented antennae in the adult female, without a tooth or denticle on the face of the tarsal claw, with marginal cerarii bearing two or more spines, at least on the caudal segments, and with anal ring bearing six setae. The derm with numerous triangular pores and some circular ones.

Type of the genus *Ripersia corynephori* Sign.

This genus has only one accredited species in Hawaii, viz., *Ripersia palmarum* Ehrhorn. It infests a variety of palms, including the so-called traveler's palm (Ravenalla), but without very serious consequences. It is mentioned here because it is commonly encountered on ornamental palms, where it is difficult to extirpate.

Descriptions of Two New Species of Encyrtidae From Mexico Reared from Mealy-Bugs (Hym., Chalcidoidea).

BY P. H. TIMBERLAKE.

(Presented by title by Mr. Fullaway at meeting of December 7, 1922.)

The following species of Encyrtidae were discovered by Mr. H. T. Osborn in the State of Vera Cruz, Mexico, in the course of his explorations for natural enemies of mealy-bugs to introduce into the Hawaiian Islands. Of these *Pseudaphycus utilis* has become established at Honolulu, but *Coelaspidia osborni* has not been recovered as yet, although liberated in large numbers. The types are in the collection of the Hawaiian Sugar Planters' Experiment Station, and paratypes will be distributed to various museums.

Pseudaphycus utilis n. sp. Figs. 1-4.

This species has a different habitus from all other species of *Pseudaphycus* known to me, but I think that it is properly placed in this genus. It is easily distinguished from all the described species of the genus and of the closely allied genera *Acerophagus* and *Bothriocraera* by its comparatively large size, entirely hyaline wings, and the bright yellow coloration with blackish pubescence on the mesonotum. In my table of the species of *Pseudaphycus* (Proc. U. S. Nat. Mus., Vol. 50, p. 570, 1916) it runs to *graminicola,* but differs in having the face and cheeks of normal length, the coloration bright yellow, the pubescence of the mesonotum dark instead of whitish, the abdomen much shorter or hardly longer than wide, the ovipositor more briefly protruded, the wings considerably wider, etc. The species is a parasite of *Pseudococcus nipae* (Maskell) and has become established at Honolulu from material collected at Orizaba, Mexico, by Mr. Osborn in the spring of 1922.

Female. General form robust, the thorax being almost as thick dorso-ventrally as wide; head rather thick fronto-occipitally, the outline in dorsal view broadly elliptical with the occipital margin slightly and broadly emarginate at the middle, the surface strongly convex from side to side; as seen from the side the outline is triangular with the facial side about a fourth longer than the dorsal side, the angulation well rounded off; as seen from

in front it is slightly wider than long, the dorsal part strongly rounded in outline, the cheeks strongly converging below toward the mouth; occiput only slightly concave, its dorsal margin acute; eyes large, broadly oval, a little broader below and not quite reaching to the occipital margin, the width of each somewhat more than a third of the total width of head; frontovertex slightly more than twice as long as wide, its sides parallel; ocelli either in an equilateral triangle or with distance between the posterior pair slightly less than the other two sides of the triangle, the anterior ocellus placed slightly behind the center of the frontovertex, the posterior pair about one-fourth their own diameter from the eyes and about twice their diameter from the occipital margin; cheeks somewhat shorter than the greatest width of eyes; the face a little longer than the cheeks, the scrobal impression moderately deep and nearly semi-circular, the scrobes proper in the form of converging lines not meeting above.

Antennae inserted far apart close to the clypeal margin; scape slender, slightly flattened but not expanded, reaching well beyond the scrobal impression of face; pedicel long and slender or about equal to the first three funicle joints and one-half of the fourth joint combined, or a little more than one-third as long as the scape proper; funicle joints gradually increasing in size distad, all somewhat wider than long, the fifth not quite twice as wide as the first; club large, oval, a little longer than the funicle, well rounded and slightly obliquely truncate at apex.

Mandibles with the two outer or ventral teeth distinct, the middle one longer and more acute, but the inner or dorsal tooth nearly rectangular. Maxillary palpi four-jointed, the joints not greatly unequal in length, the first one shortest, the apical one longest, and the third one stoutest; labial palpi indistinctly three-jointed with the middle joint very short and perhaps not always differentiated.

Thorax moderately convex above, the collar of pronotum of about the normal structure found in *Aphycus* and allies; mesoscutum twice as wide as long, without traces of parapsidal lines; axillae rather large, twice as wide as long, and meeting rather broadly at their inner tips; scutellum somewhat longer than its basal width, acute at apex, the disk strongly depressed, the lateral margins abruptly declivous and well elevated; propodeum very short medially, but longer at the sides, depressed anteriorly, but strongly declivous on posterior half, especially at the sides.

Wings reaching well beyond apex of the abdomen and moderately wide; submarginal vein with about twelve well developed setae; the marginal vein punctiform, the postmarginal somewhat longer than the marginal, but indistinct and with one moderately large seta; stigmal vein moderately long, enlarged at apex, but not slender at base as in *P. angelicus* (Howard); disk of wing uniformly pubescent, even in the basal area, the setae being considerably coarser and not so dense as in *angelicus*, the costal cell with four rows of fine setae in its basal half and with one to three rows in different parts of the apical half, the setae near apex of the cell becoming much larger; speculum very narrow next to the stigmal vein, but widening

below, where it is separated by one row of setae from the hairless streak along the posterior margin, but connecting therewith by means of an arm directed toward the base of the wing. Legs rather long, especially the middle pair; middle tibiae strongly enlarged at apex; the middle tarsi stout at base and tapering toward apex, the first joint nearly as long as the four following joints combined; tibial spur stout and as long as the first joint of the tarsus.

Abdomen hardly longer than wide and much shorter than the thorax, its apex broadly rounded, the dorsum depressed and slightly concave; ovipositor briefly protruded, the exserted part about one-fifth as long as the abdomen, or about equal to the basal joint of the hind tarsi.

Sculpture throughout extremely fine and alutaceous; under high magnification the surface of the head and notum appears finely reticulate, the reticulations of the frontovertex being rather finer than the facets of the compound eyes, those of the mesonotum considerably finer still and more transverse; frontovertex also with a few larger but very shallow pin-punctures not ordinarily perceptible, the mesonotum slightly shiny and with minute setiferous punctures; basal tergites of abdomen also with extremely fine reticulations.

Head without conspicuous pubescence, the eyes practically bare, the frontovertex with fine short hairs which are not easily seen and arranged mostly along the orbits, the occipital margin of the vertex, however, with a row of about six coarser black setae; notum of the thorax, including scutellum, with rather numerous, seriately arranged, blackish setae; tegulae with an oblique row of similar setae.

General color nearly uniformly yellow, but of different shades due to post-mortem changes, varying from light cadmium to cadmium yellow or nearly orange (Ridgway), the coloration in life being bright yellow; the lower part of the face, the cheeks, underparts of thorax, and the legs somewhat paler yellow; antennae concolorous with the upper part of face, the funicle joints often considerably darker or even slightly dusky, the club contrastingly very pale yellowish or nearly white; tibiae and tarsi slightly more brownish than the base of the legs, the tip of the last joint of the tarsi dusky; a spot on the pronotum just above the neck, the narrow obliquely placed metanotal sclerite on each side of the scutellum and the center of the abdomen above more or less extensively behind the first tergite are often more or less infuscated, varying from brownish to blackish, but any or all of these marks may be faint or absent; a narrow, transverse blackish band on propodeum just tangent to the apex of the scutellum seems always to be present, but is often interrupted at the middle; the vibrissal or cercal plates of abdomen also black, and a minute dot beside each of the ocelli usually present, due apparently to pigment transfusing from the ocelli after death, as the position of dots in respect to the ocelli varies greatly; ovipositor yellow, but usually a little darker than the abdomen, the extreme apex often dusky to blackish; mandibles

brown at apex; wings entirely hyaline, the veins very pale or nearly colorless.

Length of body, (0.907 to) 1.48; length of head, 0.514; width of head, 0.554; thickness of head fronto-occipitally, 0.309; width of vertex at posterior ocelli, 0.191; length of antenna, 0.804; width of mesoscutum, 0.577; length of fore-wing, 1.37; width of fore-wing, 0.582; length of protruded part of ovipositor, 0.129 mm.

Male. Very similar to the female in structure and coloration; eyes somewhat smaller, the ocelli larger, the frontovertex proportionately a little broader; scrobes proper of the face considerably wider, curved, and practically meeting above; antennae of the same general structure, but the scape is a little wider and with a distinct broad emargination on dorsal margin just beyond the middle, the club solid, much slenderer, and much more obliquely truncate from below upward; abdomen smaller or not over one-half as long as the thorax, the venter with a median fold. General color paler yellow than in the female, or about empire yellow (Ridgway), the dorsum of the thorax, however, more or less cadmium yellow, the underparts of thorax, coxae, and femora nearly Martius yellow (Ridgway); black markings on the metanotum, propodeum, and abdomen much more prominent than is usual in the female, the abdominal mark being triangular in shape and pale in the center.

Length of body, (1.08 to) 1.44; length of head, 0.455; width of head, 0.474; thickness of head fronto-occipitally, 0.266; width of vertex at posterior ocelli, 0.172; length of antenna, 0.683; width of mesoscutum, 0.530; length of fore-wing, 1.21; width of fore-wing, 0.533 mm.

Described from the following material reared from *Pseudococcus nipae* (Maskell) from the State of Vera Cruz, Mexico (H. T. Osborn): 68 females, 11 males (holotype, allotype male, paratypes), Orizaba, April and May, 1922; 8 females, 1 male (paratypes), Rio Blanco, collected in April and issuing up to May 8, 1922; 1 female (paratype), Nogales, April 7, 1922; 4 females (paratypes), El Potrero, July and August, 1922.

Type No. 1099, Hawaiian Sugar Planters' Experiment Station.

Coelaspidia new genus.

Similar in some respects to both *Chrysoplatycerus* Ashmead and *Zarhopalus* Ashmead, but differing in many details. The female differs from either of these genera in being apterous, the thorax increasing in width behind the tegulae, the pronotum very large, the mesoscutum relatively small, the scutellum longitudinally grooved on the disk, the abdomen very large with the dorsum very strongly convex at least in life. From *Zarhopalus* the female differs further in having a broad dorsal

margin or fold to the scape, the flagellum much more massive, with reduction in size of the pedicel and enlargement of the club, the scutellum with an apical fascicle of hairs, etc. From *Chrysoplatycerus* it differs further in having the flagellum massively clavate, with a solid club, instead of being laminately expanded, the mandibles obscurely tridentate, the apical fascicle of hairs on the scutellum much smaller, consisting of one transverse row of setae, etc.

The males of *Chrysoplatycerus, Zarhopalus,* and *Coelaspidia* are very much alike, and in the absence of females might easily be considered to belong together in one genus. The habitus of all is exactly alike, and, as the best distinguishing characters are rather recondite, I offer the following table as an aid to their recognition:

1. Mandibles narrow at apex, with an acute median tooth and an angulation on each side, producing an obscurely tridendate condition; flagellum circular in cross-section, sensoria present, but not producing a rugose effect, the first funicle joint and pedicel, not greatly unequal; marginal vein no longer than thick..... 2

   Mandibles narrow at apex and plainly bidendate, with the inner tooth much longer than the other; flagellum oval in cross-section, densely covered with short linear sensoria, producing a marked rugose effect, the pedicel much smaller than the first funicle joint; wings very broad, strongly triangular in shape, the marginal vein about two or three times as long as thick. .*Chrysoplatycerus* Ashmead

2. Scape, excluding radicle, a little longer than the pedicel and first two funicle joints combined, and only slightly widened beneath; wings rather broad and triangular in shape, the submarginal vein not thickened apically .....*Zarhopalus* Ashmead

   Scape, excluding radicle, no longer than the pedicel and first two funicle joints combined; distinctly, although not greatly, expanded beneath and concave on the outer surface; wings of about normal breadth and not at all triangular in shape, the submarginal vein slightly, but distinctly, thickened in the distal third of its course. *Coelaspidia* new genus

Female. As compared with *Chrysoplatycerus* the head is thicker frontoccipitally, the eyes much smaller so that the frontovertex becomes considerably wider, or about a third of the total width of the head; occiput deeply concave above, the occipital margin acutely, but not very sharply, angled; scrobal impression very deep and semi-circular, as in *Chrysoplatycerus.* Antennae similar as to the scape, but the flagellum is not laminate, it being much shorter, compressed and massively clavate, the cross-section of any part being oval, the joints all closely packed together; pedicel sub-

triquetrous and fully one-half as long as the funicle; the latter six-jointed, each joint much broader than long, the first much the smallest, it being considerably narrower than the apex of the pedicel, the following joints becoming successively much broader, but hardly increasing in length; club solid, somewhat greater in length and bulk than the funicle, but only slightly wider than the preceding joint, suboval in shape, the apex obliquely and roundingly subtruncate beneath. Mandibles very slender, obscurely tridentate at apex, there being a prominent, very acute median tooth flanked on both sides by a much smaller tooth, the inner or dorsal one forming nearly a right angle with the inner margin of the mandible. Palpi short, maxillary pair four-jointed, apical joint about as long as the basal three combined, acute and with long hairs at apex, the second longest of the other three joints; labial pair three-jointed, the basal joint longest and over twice as long as the second, which is shortest; apical joint blunt at apex, with shorter hairs than on maxillary palpi.

Thorax moderately robust and convex above, increasing in width behind the tegulae; pronotum large, anteriorly conical, the collar as long as the mesoscutum, its posterior margin only slightly arcuate; mesoscutum short and transverse, about twice as wide as long, its anterior corners foveate; axillae well developed, not greatly wider than long, their inner tips acute and meeting medially or nearly so, their outer sides abruptly declivous; scutellum as long as the mesoscutum, five-sided, the apex being rather broadly truncate, the sides abruptly declivous and forming a sharp margin with the disk, the latter distinctly, although not deeply, concave except at apex, and sloping backward; propodeum large, sloping obliquely backward, hardly longer at the sides than at the middle, the spiracles small and almost circular.

Coelaspidia osborni.

Wings rudimentary, reaching only to the anterior margin of the propodeum. Legs of the normal length and structure, the middle tarsi tapering toward the apex, the first joint nearly as long as the following joints combined; spur of middle tibiae a little shorter than the first joint of the tarsus; hind tibiae with two short unequal apical spurs; hind tarsi slender, the first joint about equal to the last three joints combined.

Abdomen unusually large, or fully as long as the head and thorax combined, and much wider, convex above and beneath, with the apical part of the dorsum behind the vibrissal plates often, but not always, shrunken in after death; first tergite about twice as long as the second, which, with the following, except the last, decrease successively in length, the apical one being nearly as long as the three preceding combined; vibrissal plates or cerci situated at one-fourth the length of the abdomen from the apex; ovipositor entirely enclosed and concealed by the ventrites and without protruding sheaths.

Frontovertex very finely lineolate; pronotum and mesonotum and first tergite of abdomen finely reticulate; other parts of the body mostly smooth. Vestiture throughout very fine and sparse, being most abundant and conspicuous on the collar of the pronotum and on the mesoscutum; apex of the scutellum with a small, short fasicle of hairs consisting of about twelve fine black setae arranged in a transverse row close together, the outer pair of setae very short, the middle setae longest.

Male. With fully developed wings and very similar to the male of *Chrysoplatycerus*. Head considerably thicker fronto-occipitally, the occiput very deeply concave; as seen from above, well rounded on the sides, transverse anteriorly between the eyes and deeply emarginate at the occipital margin; in side view the dorsal and facial sides of the triangular outline are about equal. Antennae agreeing closely, the scape short, very slender in dorsal view, but compressed and somewhat expanded below, concave on the outer surface, pedicel about as long as thick at apex, and not much smaller than the first funicle joint; flagellum stoutly cylindrical, the funicle not tapering distad, each joint about as long as thick and nearly circular in cross-section, club solid and as long as the two and one-half preceding joints combined; entire funicle densely clothed with extremely fine short hairs, the club more sparsely pubescent; sensoria of the flagellum inconspicuous and not producing a rugose effect as in *Chrysoplatycerus*. Mouth parts as in the female.

Notum of the thorax very convex from side to side; the collar of pronotum very narrow and strongly arcuate; axillae very acute and meeting at their inner tips under the overlapping margin of the mesoscutum; scutellum rounded at apex. Fore-wings moderately wide, not triangular in shape, as in *Chrysoplatycerus;* marginal cilia short, the discal pubescence moderately dense and covering entire membrane, excepting the rather wide speculum; venation as in *Chrysoplatycerus*, except that the marginal vein is no longer than thick, the submarginal slightly thickened in the distal third of its course, and not thickened toward the base. Abdomen and legs

showing no distinctive differences from *Chrysoplatycerus*. Sculpture, vestiture, and type of coloration of the same character, excepting that the eyes are densely pubescent.

Genotype: *Coelaspidia osborni* n. sp.

Coelaspidia osborni n. sp. Figs. 5-9 and text figure.

Female. Head, as seen from above, strongly rounded on the sides, deeply concave at occipital margins, truncate and slightly concave in front; in side view, increasing in thickness fronto-occipitally from above downward to a point opposite the lower ends of the eyes; in frontal view, slightly wider than long, the outline well rounded on the sides and below and considerably flattened dorsally; eyes of medium size, broadly oval, and a little wider on the anterior half, well separated above from the occipital margin; frontovertex a little over twice as long as wide and increasing slightly in width anteriorly; the frontal ledge between the eyes and the scrobal impression not transversely grooved, as in *Chrysoplatycerus splendens* (Howard); ocelli minute and arranged in slightly less than a right-angled triangle, the posterior pair placed a little more than their own diameter from the margin of the eyes and remote from the occipital border; scrobal impression broadly transversely oval, the prominence between the antennae nearly as broad as long.

Antennae inserted far apart, rather close to the clypeal margin; scape projecting for about two-thirds of its length beyond the scrobal impression; excluding the radicle, it is somewhat less than twice as long as wide, obliquely truncate at base on the dorsal side and broadly rounded at apex; its dorsal margin folded in an acute angle with the inner surface, thus forming a flat dorsal surface which increases in width toward the apex and forming a groove beneath on the outer side for the reception of the following joints; pedicel as long as thick and not cupped at apex; joints of flagellum closely joined into an elongate oval mass; the funicle somewhat smaller than the club, its first joint about one-third as wide as the sixth, with the intervening joints becoming gradually wider; club slightly wider than the funicle and somewhat acute at apex.

Frontovertex microscopically and transversely lineolate, the lines showing only a slight tendency to form reticulations, and with very minute, shallow, sparsely scattered pin-punctures; scrobal impression highly polished, the facial prominence between the antennae rather rugulosely and very finely shagreened; pronotum, mesoscutum, axillae, and scutellum finely reticulate, the pronotum being subrugulose and the scutellum smooth and becoming considerably polished toward the apex; pleura, propodeum, and abdomen smooth and polished, the first tergite nevertheless being finely reticulate.

Eyes bare; frontovertex with very short, fine setae, which are well scattered, quite inconspicuous, and inclined forward; facial prominence with fine whitish setae; pronotum with rather numerous fine reclinate setae, which are whitish in color; mesoscutum, axillae, and scutellum with similar,

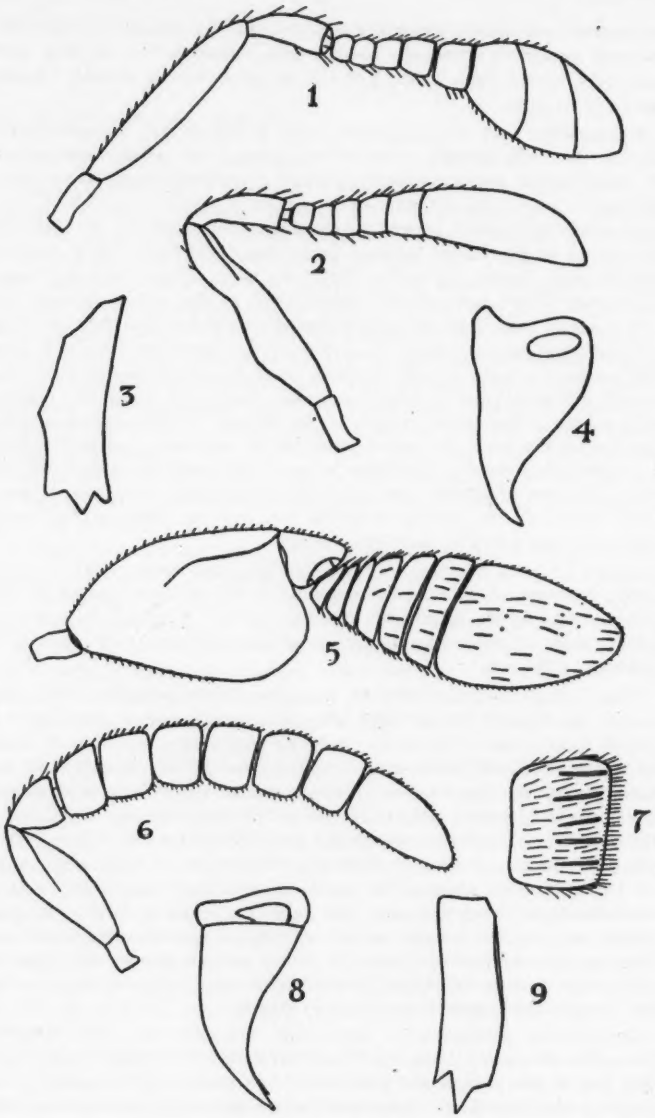
but sparser, pubescence, which becomes progressively sparser and less conspicuous posteriorly; abdomen nearly bare, although the tergites bear some very sparse, short setae, and the venter a few much longer hairs, especially at apex.

General color dark metallic green with a bronzy luster; the mesopleura, tegulae, the fovea at each corner of the scutum, the posterior margin of the basal tergite, and a connecting median longitudinal band on the same segment, which tapers forward, dark purple; a median longitudinal purplish band also usually present on the mesoscutum; rest of the first and the second tergite bright metallic green, the following tergites greenish with a purple luster, the venter darker or more or less blackish; facial prominence, lower part of the cheeks, sides of the notum between the scutellum and base of the wings and propodeum more or less brownish with a green luster, or occasionally in a few of the paratypes the whole head and notum are more or less brownish with a metallic luster, thus producing a marked bronzy effect; antennae black, the scape and pedicel paler except on the ventral margin of the former (in slide mounts appearing distinctly brown), the dorsal expansion of both scape and pedicel with a bright green luster; mandibles brown; legs brownish yellow, all the coxae, the apex of middle tibiae, and the middle tarsi, except apical joint, paler yellow, all the femora on apical half and the tibiae on basal half infuscated and somewhat metallic greenish.

Length of body, (0.59 to) 1.64; length of head, 0.452; width of head, 0.490; thickness of head fronto-occipitally, 0.287; width of vertex at posterior ocelli, 0.169; length of antennae, 0.676; width of mesoscutum, 0.377; width of propodeum, 0.452; length of abdomen, 0.860; width of abdomen, 0.664 mm.

Male. Head hardly wider than long, the cheeks somewhat converging toward the broadly rounded oral margin; eyes of medium size, about a fourth longer than wide, broadly rounded anteriorly; frontovertex about as long as wide, and widening both in front and behind on account of the curvature of the eye-margins; ocelli large, arranged in a right-angled triangle, the anterior ocellus just behind the center of the frontovertex, the posterior pair almost touching the occipital margin and placed a little more than their own diameter from the eyes; cheeks as long as the width of the eyes; face concave, the antennal prominnce not much elevated, somewhat longer than wide, and just above the antennal sockets changing into a very narrow rounded carina-like ridge, which ascends medially to the angulation between the face and frons; on each side of this ridge lie the shallow scrobes, which are parallel in the upper third of their course and diverge below toward the antennal sockets.

Frontovertex subrugulosely, transversely reticulate and with numerous fine scattered pin-punctures; face much smoother, being finely scaly-reticulate, the scrobes smooth and polished; cheeks exterior to the genal suture longitudinally reticulate; mesonotum finely, transversely reticulate and with very fine punctures; the scutum subrugulose, but not so rough as the



Mexican Encyrtidae.

frontovertex; the axillae and scutellum smoother, the latter being considerably polished at apex; propleura, prepectal plates, and metapleura very finely scaly-reticulate, but nevertheless smoothish and shining; the reticulations on the metapleura much less apparent; mesopleura smooth and polished; abdomen comparatively coarsely, transversely reticulate, especially on the basal tergite, with the reticulations formed by fine raised lines, each reticulation generally over twice as wide as long.

Lower part of face, the cheeks, frontovertex, eyes, and mesonotum rather densely covered with fine, short, dark-colored setae, which are reclinate on the notum, erect and somewhat shorter on the eyes, suberect on the frontovertex, and inclined forward on the face and cheeks; scutellum with a pair of fine and considerably longer setae on each side of apex; pubescence of abdomen rather sparse and longer than that of the thorax, but not in any way conspicuous or distinctive.

General color dark metallic green, the face brilliant green, with the upper part of the antennal prominence above the socket dark purple; mesopleura also somewhat purplish; abdomen nearly black with a purplish and greenish luster; antennae black; legs metallic blackish with trochanters, base of all the femora, knee joints, tip of hind tibiae, apical third of front and middle tibiae and all the tarsi except apical joint brownish yellow, this color of the middle tibiae and tarsi being somewhat paler, and the hind tarsi dusky above; mandibles brown; the palpi yellowish white; wings hyaline, with dusky yellowish veins.

Length of body, (0.655 to) 1.07; length of head, 0.384; width of head, 0.419; thickness of head fronto-occipitally, 0.252; width of vertex at anterior ocellus, 0.209; length of antenna, 0.659; width of mesoscutum, 0.421; length of fore-wing, 0.912; width of fore-wing, 0.426 mm.

Described from 153 females, 59 males (holotype, allotype male, and paratypes) reared from *Pseudococcus calceolariae* (Maskell) on sugar-cane collected at El Potrero, Vera Cruz, Mexico, in May, June, and July, 1922, by H. T. Osborn, and in part bred in Honolulu from the same host and also from *Pseudococcus sacchari* (Cockerell) and *Pseudococcus kraunhiae* (Kuwana).

Type No. 1100, Hawaiian Sugar Planters' Experiment Station.

EXPLANATION OF PLATE XI.

Figs. 1–4, *Pseudaphycus utilis.*

1, Female antenna.

2, Male antenna.

3, 4, Frontal and dorsal view of mandible of female.

Figs. 5–9, *Coelaspidia osborni.*

5, Female antenna.

6, Male antenna.

7, Sixth funicle joint of male antenna greatly enlarged.

8, 9, Dorsal and frontal view of mandible of female.

OBITUARY.

Dr. David Sharp, M. D., F. R. S., etc.

To our society the death of Dr. David Sharp is an irretrievable loss. The work and time which he devoted to the entomology of our Islands and the influence he exercised upon others working on our insect fauna placed him in a unique position. His death removes the second of the three men to whom we owe most of our knowledge of our insects.

Sharp was born at Towcaster, Northamptonshire, England, in 1840, but his parents moved to Stony Stratford, where he spent the first ten or eleven years of his life, and afterward to London. In 1853 he entered St. John's Foundation School, where he remained until he left to enter his father's business. At this time Herbert Spencer was living with his family, and it is evident that the writings and personality of this eminent philosopher influenced Sharp's mind and perhaps gave it that keen and logical quality which characterized his whole life and works.

Finding commercial life uncongenial he decided to study medicine. He first attended St. Bartholomew's Hospital, London, and afterward studied at Edinburgh University, where he graduated in 1866 with the degrees M. B. and C. M. After acting as assistant to his family's doctor in London he moved to Thornhill, Scotland, in 1867, where he was appointed to the Crichton Institute at Dumfries. In 1884 he moved to Southampton, England, and later to Dartford, Kent. In 1890 he was appointed curator of the insect collection of the University Museum of Zoology, Cambridge, where he remained until 1909, when he retired to Brockenhurst, in the south of England, for the rest of his life. He died August 27, 1922, shortly before his eighty-second birthday.

Sharp was interested in insects when a boy and collected Lepidoptera before he left school. He must have turned his attention to Coleoptera shortly before 1861; his note book of captures begins on April 16 of that year. His first publication was in 1865 and is a short paper on British species of Agathidium. In 1869 he published "A Revision of the British Species of Homalota," which showed his great ability for systematic work. He retained his love for the Staphylinidae all

through life and described Bate's collection from the Amazon, the collection for the Biologia Centrali Americana, collections from Japan and other smaller collections. His biggest single work was "On Aquatic Carnivorous Coleoptera or Dytiscidae" (1882), and it is of interest as he carried out a synthetic system of nomenclature on lines laid down in his pamphlet, "The Object and Method of Zoological Nomenclature" (1873). The work by which he is most generally known to entomologists is his "Insecta" in the Cambridge Natural History, one of the most readable and lucid textbooks on entomology.

But zoologists will always remember him for the time and labor he devoted to the Zoological Record. He acted as recorder of insects from 1885, and as editor of the work as well as recorder of insects from 1892 until a few weeks before his death. To many men this work alone would have been a life's work, and one wonders how he found time for so much besides. He had great powers of concentration, never wasted time, and he could turn from one subject to another without loss of time picking up the threads of his work. In zoological matters his judgment was sound, and he never allowed himself to be carried away by the various controversial subjects that have divided biologists during the last sixty years. While he appreciated the good in many of the theories brought forward, his keen mind could always see their limitations.

Sharp was deeply interested in island life and it is this aspect of his work which is of greatest interest to the members of this Society. He wrote a number of papers on the Coleoptera of New Zealand and started the late Major Broun on his entomological career. He wrote many papers on Japanese Coleoptera, and in 1888 was appointed a member of the committee to examine the fauna and flora of the West Indies. His friendship with the Rev. Thomas Blackburn brought him into personal relation with the Hawaiian Islands.

When this friendship began I am not able to find out, but in his note book we find that he was exchanging specimens with Blackburn in August 9, 1865. From 1876 to 1882 the Rev. Thomas Blackburn resided in Honolulu as chaplain to the bishop and senior priest of the cathedral, and although his duties allowed him very little time for collecting, yet he man-

aged to get a number of our interesting insects. In those days traveling about the Islands was vastly more difficult than at present. There was no Mountain Trail Club to cut trails through the forests, and a climb to the back of Tantalus and back was a hard day's work.

From 1877 to 1897 Sharp and Blackburn published a number of separate papers on the Coleoptera, and in 1885 they published a joint Memoir, bringing all the information together. Other specialists worked at other orders collected by Blackburn. This work demonstrated the unique quality of the fauna of the Islands and led to a desire for a more extended investigation. Owing to the advocacy of Prof. Alfred Newton and Dr. Sharp, the British Association for the Advancement of Science appointed a committee in the year 1890 "to report on the present state of our knowledge of the Sandwich Islands, and to take steps to investigate ascertained deficiencies in the fauna, with powers to co-operate with the committee appointed for the purpose by the Royal Society, and to avail themselves of such assistance as may be offered by the Hawaiian Government or the trustees of the museum at Honolulu." The two committees worked together for twenty-two years when the work was closed. During these years Sharp acted as secretary and also as editor to the three volumes of the Fauna Hawaiiensis and worked on important sections of the Coleoptera.

His sound judgment was shown in selecting Dr. R. C. L. Perkins as field naturalist, and to the labors of these two, and, in a lesser degree, to the other specialists who worked on the different groups of insects, we owe the Fauna Hawaiiensis. In no other group of islands in the tropics have the insects been worked out so completely. Through this work we have been able to realize fully the unique endemism of the fauna, to recognize the later emigrants from the native insects, and to see evolution "in being" in a more simple form than in any other part of the globe. It has also enabled us to carry on a line of economic work with an understanding that would have been impossible without it, and which has resulted in a saving of many millions of dollars to the agriculture of the Islands. This work in turn has been a huge experiment on the death factors

of insects and has added a distinct chapter to our understanding of Natural Selection.

All scientific work if truthfully carried out eventually finds its place in the sum of human activities, but few entomologists working along purely scientific lines have lived to see their work bear such practical results as have Sharp, Blackburn, and Perkins, the three founders of Hawaiian entomology.

The number of Sharp's writings is over 250, and it has only been possible to list those dealing with the Hawaiian Islands.

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1878. On some Longicorn Coleoptera from the Hawaiian Islands. Trans. Ent. Soc. Lond., pp. 201-210.

1879. On some Coleoptera from the Hawaiian Islands. Trans. Ent. Soc. Lond., pp. 77-105.

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1884. On some genera of the sub-family Anchomenini (Platynini Horn), from the Hawaiian Islands. Ent. Mo. Mag., XX, pp. 217-219.

1885. Notes on the genus *Plagithmysus* Motsch. C. R. Soc. Ent. Belg., p. LXXIV-VI.

1885. Memoirs on the Coleoptera of the Hawaiian Islands. Trans. R. Dublin Soc. (2), III, pp. 119-300, pls. IV, V, by Blackburn and Sharp.

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1897. On *Plagithmysus:* a Hawaiian genus of Longicorn Coleoptera—Supplement. Ent. Mo. Mag., XXXIII, p. 12.

1919. Studies in Rhynchophora V. The genus Rhyncogonus. Proc. Haw. Ent. Soc., IV, pp. 77-82.

FAUNA HAWAIIENSIS.

Editor of the three volumes and writer of the following parts:

1900. Coleoptera Phytophaga, II, pp. 91-116.
1903. Coleoptera Caraboidea, III, pp. 175-292.
1908. Coleoptera III, pp. 367-579. Sharp and Scott.
1910. Coleoptera III, pp. 645-650. Sharp and Perkins.
1913. Preface, XI-XIII.

F. M.

Immigrant Records for 1922.

BY THE EDITOR.

This is a list of the immigrant insects recorded for the first time in 1922. Many of them have been known for some time, but have remained undetermined or unrecorded, and are now recorded with recent determinations. Those marked with an asterisk were observed or collected for the first time during the year. For details of records, etc., refer to the pages given.

Page

* *Terastia meticulosalis* Guen. (Lep.) 180, 297
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